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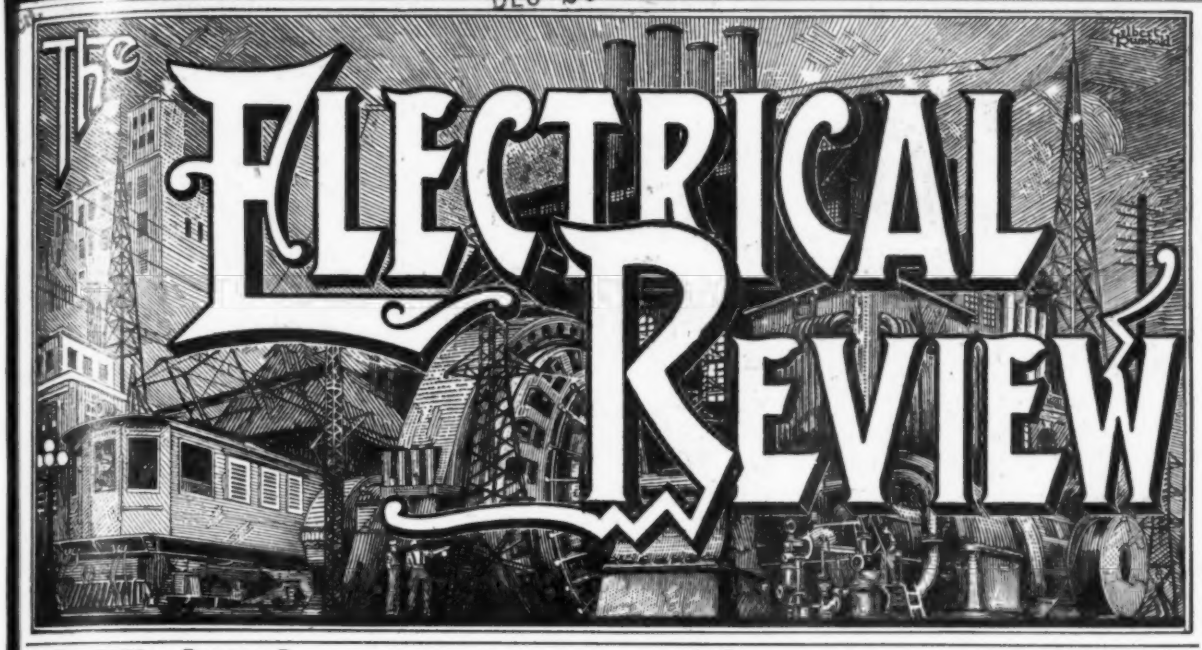

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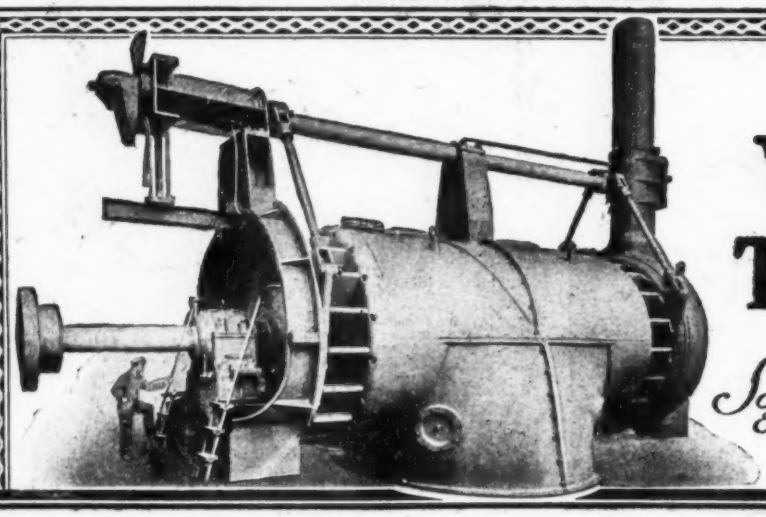

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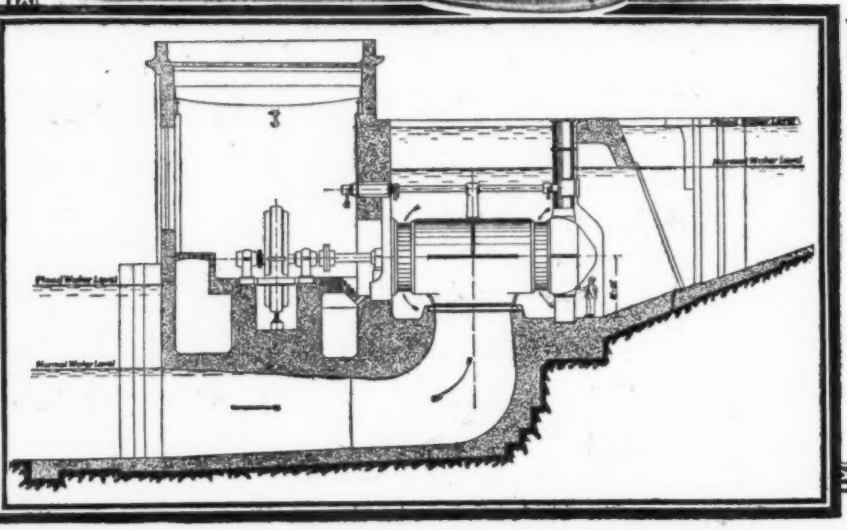

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THE

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VOL. XCIII. DECEMBER 14, 1923. No. 2,403.

ELECTRICAL REVIEW.

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The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

FOREIGN AGENTS:

AUCKLAND, N.Z.: Gordon & Gotch, Albert Street; Peter G. Tait, P.O. Box 392; R. Hill & Son, Matlock House, 33/34, Quay Street; Trade Publications Co., 302, N.Z. Insurance Buildings, Queen Street.

BRISBANE: Gordon & Gotch, Queen St.

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WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

SUBSCRIPTION RATES, Postage Free: United Kingdom, £1 14s. 8d.; Canada, £1 12s. 6d.; Colonial and Foreign, £2 1s. 6d. per annum.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, LIMITED, and crossed "Midland Bank, Newgate Street Branch."

EARLIER PUBLICATION OF THE "ELECTRICAL REVIEW."

FOR many years it was our custom to publish the ELECTRICAL REVIEW so that it could be in the hands of the reader first thing on Friday morning. Under the difficult conditions which arose several years ago, circumstances beyond our control made it necessary for us to depart from that arrangement. It has been our intention to revert to the former printing hours at the earliest convenient moment, for we have been fully aware of the desire of many readers to avail themselves of the information given in some of our regular sections well in advance of the week-end.

We are glad to be able to announce that our long-deferred hope is about to be more than realised, for commencing with the first issue in the New Year (Friday, January 4th, 1924) all of our United Kingdom subscription readers outside London will have their ELECTRICAL REVIEW delivered to them by the first post on Friday morning. Those ordering their copies through newsagents should be supplied at about the same time.

Subscribers in the London Postal District should receive the REVIEW late on Thursday night, instead of by the last post on Friday as at present.

We believe that this further effort on our part to meet the convenience of our readers, and the requirements of the trade, will meet with general approval.

No effort will be spared to ensure that the up-to-date character of the week's news and the general contents of the journal shall be maintained, and we invite the co-operation of all correspondents and contributors to that end.

ELECTRICITY IN MINES.

FROM the extracts taken from the annual report of the Chief Inspector of Mines which are appearing in our columns, it will be seen how vastly important the use of electricity in coal mining has become.

In ten years the h.p. of motors installed has more than doubled; in 1922 the increase in electrical horse-power was 92,071 h.p. over the previous year, and we are confident that it is bound to go on increasing year by year. As the cost of production increases due to labour demands, and the selling price decreases due to competition, there inevitably comes a time when one of two things must happen—either the closing of the mine or some reduction in the cost of production by the installation of labour-saving machinery, and an increased output. To transmit the power to drive this machinery electricity is now a necessity. We may even go so far as to say that were it not for the advent of electricity, some mines which to-day are working at a profit would have been closed, especially those mines which depend upon coal-cutting machinery. In 1921, 14 per

cent. of the total output was obtained by coal-cutting machinery; in 1922 this was increased to 15 per cent. In one district in Scotland 46 per cent. and in another 43 per cent. of the total output was mined by machinery. In the former, 858 electrically-driven machines are employed in 165 mines, against 48 driven by compressed air; in the latter 252 electrical and 36 compressed air machines are employed in 49 mines. Yet important as electrically-driven coal-cutting machines are, they form only a small percentage of the total horse-power used in and about mines, for out of a total of 1,240,174 h.p., only 68,886 h.p. is applied to coal cutting, and of the remainder more than half is applied to haulage and pumping below ground. 76,248 h.p. is applied to winding, 89,207 h.p. to ventilation, 59,475 h.p. to haulage, 87,746 h.p. to coal washing and screening, and 239,472 h.p. to miscellaneous purposes above ground. From this it may easily be realised what a vast amount of complicated and expensive plant is in use at the 1,557 mines where electricity is installed, out of a total of 2,911 mines at work in 1922, and it is also evident that the other 1,354 mines will be compelled sooner or later to install electrical plant to keep up to date or else go out of use.

It is, however, very much to be regretted that the Inspector had to report no fewer than nine fatal accidents directly due to electricity—"*particularly because they may all with one doubtful exception be properly classed as preventable accidents.*" Again, out of 40 non-fatal accidents reported, 13 were due to faulty design or construction; 8 to defective maintenance; 7 to misuse, negligence, ignorance or meddling; and only 12 were considered unforeseeable.

This is the first occasion on which any inspector has drawn attention to the serious state of affairs in the management of colliery electrical equipment, and our readers will be able to grasp the position themselves by a perusal of the extracts given in our columns. It could scarcely be worse—but no suggestion is made for remedying matters.

There is but one remedy, and that is to appoint fully-trained, thoroughly qualified, and certificated engineers to take entire charge of and be responsible for the proper operation and maintenance of the whole mechanical and electrical equipment. For years past we have drawn attention to this question. Though we were as a voice crying in the wilderness, our persistence resulted in the formation of the Association of Mining Electrical Engineers, and we held high hopes that something would be done, but the colliery managers and mechanical engineers soon stifled any movement in this direction, and to-day the majority of the men who ought to be its main supporters are conspicuous by their absence.

At the October meeting of the Midland Institute of Mining Engineers, however, Sir William Ellis, G.B.E., a vice-president of the Institution of Civil Engineers, read a paper on "The Position of Mechanical Engineering in Colliery Operations," and among other things he said: "The point I wish to urge . . . is that the time has come when the mechanical engineer of a more technical and wider training should be included amongst the staff of a colliery, and that he should have given him a status higher than has previously been the custom."

The paper was fairly well received, though one member described it as "throwing such a bomb amongst us," and in the ensuing discussion Sir Richard Redmayne supported Sir William Ellis. The discussion of the whole question, however, will occupy more space than we have available at present, and therefore we propose to return to this subject shortly.

Delayed Deliveries.

A LARGE part of our "Correspondence" section this week is occupied by a number of letters relating to the ever-important question—time of delivery. In some of the ways of life promises may be made with the pie-crust tendency without very serious consequences, but in trade the fulfilment of promises of delivery is imperative on the part of those who wish to carry on successfully. To undertake to complete orders by a specified date and then fail to complete as promised, carries heavy contract penalties in some cases, but whether or not there are contract conditions involving penalties, the damage done to the reputation of the defaulter is no trifling matter. To accept business at a competitive figure, trusting to Providence to enable delivery to be given by a certain date—in other words, with little more than "hope" to justify the promise—may prove to be short-sighted and disastrous. Not only is it foolishness on the side of the supplier, but it is grossly unfair to the customer and, of course, may bring the industry a bad name. Naturally, one recognises that at times exceptional circumstances may be to blame for over-due delivery—some of these are mentioned in our "Correspondence"—but these letters and the other evidence that has come before us do not relate to the exceptional. It appears that the trouble is not limited to either small or large producing and selling organisations—both are the object of criticism. We cannot imagine that the electrical trade, with the vastness of its operations and the large number of its transactions, is deficient in up-to-date control of productive operations or incompetent on the commercial side of its organisation. There are plenty of highly-qualified men in the industry who should be capable of setting things right. Is it that they have not the necessary authority or status, or is there excessive elaboration of operations or obsession with ideas of "system"? Can it even be that there is want of "system" or that subordinates lack interest? We invite other readers to contribute their views to the discussion now that it has been set going. Let it be remembered that the suppression of the subject—the adoption of an ostrich-like attitude—will do nobody any good, but may do British electrical trade reputation at home and abroad considerable harm. If things are n t as the critics represent, let that be emphatically stated, but if there is room for improvement, as we understand there is, let every concern look to its own affairs and introduce suitable measures so that the personnel and the machinery of its organisation may give that efficiency which should be its first consideration. Perhaps it is difficult under prevailing organisation to estimate demand so as to manufacture for immediate and stock requirements. Perhaps we scatter our productive efforts over too wide a range of manufactures instead of concentrating in special items in special works? Perhaps there is room for central depôts stocking large supplies of standard products of many manufacturers. For the welfare of the industry as a whole, let those who have ideas express them.

Extra-high-Pressure Transmission of Energy.

IN his interesting report of the proceedings at the Extra-High-Pressure Transmission Conference, Mr. R. Borlase Matthews last week expressed the conviction that the time had arrived for the inter-linked electrification of the whole of this country; and this week he goes on to urge the necessity of consultation, in order that the engineers of each country may know what their *confrères* in other lands are doing. Whatever may be thought of the former conclusion, we believe that the latter will be fully demonstrated by the contents of his report. In this issue the rapid adoption of automatically-operated sub-stations in the United States is emphasised; several such sub-stations are in use or in course of erection in this country, and important progress in this direction may be counted on. In the use of mercury-vapour-rectifier sub-stations Birmingham Corporation has taken the lead and may have something to tell our American visitors next year. As for the use of very high pressures, it is not long since 30,000 volts was regarded as ample for our insular needs—but far higher pressures are already contemplated, and we may see 100,000-volt lines in operation before long.

THE PRINCIPLES OF QUANTA SIMPLY EXPLAINED.

By R. W. WESTERN.

It has been established by careful investigation in many branches of physics that the action of light in radiation is discrete; that is to say, discontinuous: just as matter can only be transferred, by chemical means, in atoms of definite weight; so the action of light can only be radiated in quantities of definite magnitude; in fact, experiment shows the action of light to be atomic. From this it is clear that radiation of light must be conducted on principles very different from that of sound, for whereas sound is generated, say, in a pipe, so long as vibrations are excited in the air it contains; no radiation of light is brought about by vibrations or revolutions in the atom until excitation changes. Electrons are supposed to revolve about the nucleus of an atom in many orbits, but their revolutions do not generate light; that occurs when an electron deserts a large orbit in favour of a small one; then, and then only, does radiation take place. Hence, steady illumination can only be obtained as the joint effect of this change in a great number of contiguous atoms; indeed, the effect may be compared with that of a Russian one-note choir, in which each singer contributes his best note, and only that.

The word "action," as used in the quantum theory, has a special meaning imported from celestial mechanics, the ready application of which to the system composed of one or more electrons revolving about the nucleus of an atom is one of the most felicitous developments of recent science. This meaning is most concisely conveyed by the expression—

$$\int m\,v\,ds$$

which is as much as to say, the momentum of a body at each representative point in its path, multiplied by the lengths of the path represented by each point; these products being added together. Thus, for a circular path described by an electron, the *action* in a complete revolution would be—

$$\int_0^{2\pi r} m\,v\,dr = 2\,\pi\,m\,v\,r,$$

for since m, the mass of the electron, and v, its velocity, are the same throughout, we have simply to multiply $m\,v$ by $2\,\pi\,r$, the circumference of the circle. The principle of quanta requires that the quantity thus obtained for the whole period of any periodic motion like that of rotation, must always be some exact multiple of a fixed quantity—an indivisible atom of *action*, known as Planck's constant, usually denoted by h. Thus,

$$2\,\pi\,m\,v\,r = n\,h.$$

So, just as a chemical substance can only alter in composition by definite ratios determined by the weight of the atoms concerned in the change, this *action* of an electron can only be altered in definite proportion determinated by the magnitude of h, which is 6.55×10^{-27} in C.G.S. units. It is to be noted that if t be the time occupied by a revolution of the electron—

$$\frac{2\,\pi\,m\,v\,r}{t} = m\,v^2, \text{ because } \frac{2\,\pi\,r}{t} = v;$$

that is to say, the average *action* per unit of time is equal to the energy of the electron doubled. In this case its average energy is the same as its energy at any moment, because the motion is constant; this is the general relation of *action* to energy, and helps to make its nature more intelligible. Since the dimensions of energy are the same as those of work, namely, Force × Space, the dimensions of *action* are seen to be: Force × Space × Time.

The requirement imposed by the principle of quanta is of far-reaching effect; for example, it fixes the circular paths an electron is able to traverse. These, instead of being infinite in number, become restricted to circles having radii which stand in the ratios of 1, 4, 9, 16, &c. It is true that elliptical paths are also possible, but these are also limited in number; and as the present purpose is only to explain the principle involved, it will be sufficient to show how the limitation applies in the simpler case presented by circular paths. To do this, we have only to consider the conditions that must be fulfilled in order to maintain the revolution of an electron in its orbit. The electric charge on the electron is the same as that of the nucleus and equal to e; while the attraction between the two, being inversely proportional to the distance between them, is equal to e^2/r^2, where r is the radius of curvature of the path. This attractive force must be equalled by $m\,v^2/r$, the so-called centrifugal force arising from the resistance of the electron to change in the direction of its motion.

$$\text{So } \frac{e^2}{r^2} = \frac{m\,v^2}{r}\text{; and } v^2 = \frac{e^2}{m\,r}.$$

The condition imposed by the principle of quanta has already given us: $2\,\pi\,m\,v\,r = n\,h$. So $v = n\,h/2\,\pi\,m\,r$. Hence, the square of $n\,h/2\,\pi\,m\,r$ is equal to $e^2/m\,r$, as obtained above

$$\text{Whence } e^2 = \frac{n^2\,h^2}{4\,\pi^2\,m\,r}\text{; and } r = n^2\,\frac{h^2}{4\,\pi^2\,e^2\,m}.$$

Now, π, h, e, and m are all constant quantities that undergo no change during revolution of the electron, while n is a whole number; so when n is made 1, 2, 3, 4, &c., the corresponding values of r must stand in the ratios of 1, 4, 9, 16, &c., as stated. Strictly speaking, the electron revolves, not about the nucleus as a centre, but about the common centre of gravity of them both; since, however, the distances of the centre of gravity from the nucleus and from the electron stand as a yard to a mile, the correction is not great. This restriction of the possible orbits in which an electron may revolve is thus an immediate consequence of the restriction which the principle of quanta imposes on its *action*, namely, that for each revolution the *action* must be an exact multiple of h—the constant called after Planck.

We have next to see in what way the energy of the electron is conditioned by this limitation. Its kinetic energy in any orbit must be $m\,v^2/2$, and this is equal to $e^2/2\,r$, because $v^2 = e^2/m\,r$, as we have seen; and since the orbit is fixed, the energy is fixed so as to be unalterable as long as the electron continues to revolve in that orbit. The electron has also potential energy due to the attraction of the nucleus, which is a force equal to $-e^2/r^2$; this energy is, of course, greatest when the electron is far away. If it has already approached the nucleus near enough to have reached the circumference of a circular orbit of radius r, the potential energy so far exhausted will amount to—

$$-\int_\infty^r \frac{e^2}{r^2}\,dr,$$

which is equal to e^2/r, and that is twice the amount of the kinetic energy. Thus, in whatever orbit the electron revolves, half the whole of its possible energy has disappeared, and the question is: what has become of it?

If we were dealing with satellites or planets instead of electrons, the answer might be that it had been dissipated in the friction of tidal flow; or we might think

the revolving body was born of the central body about which it revolves, and was never possessed of so much potential energy to lose. With an electron, however, the answer is: it has been radiated away in the form of light—visible or invisible. Then, since there can have been no loss of energy while the electron continued to revolve in any one of the several orbits permitted to it by the principle of quanta, the radiation by which the loss occurred must have taken place during transitions between one and another in changing from an outer to an inner one.

Now r, as we have seen, must be—

$$n^2 \frac{h^2}{4\pi^2 e^2 m},$$

where n is an integer. So the radius of the smallest possible circle will be obtained by making n equal to 1, which gives us—

$$r_1 = \frac{h^2}{4\pi^2 e^2 m}.$$

The radius of the next circle is obtained by putting $n = 2$, so that it will be four times as great as the first; the next will be nine times, and the next after that 16, and so on, proceeding in the order of the integers squared.

Then, since the kinetic energy in any orbit is $e^2/2r$, the kinetic energy of the electron in the smallest circle of all must be—

$$2\frac{\pi^2 e^4 m}{h^2}.$$

The kinetic energy of the electron in the next circle will be $\frac{1}{4}$ of this, and in the next to that $\frac{1}{9}$ and so on, in the same progression; while the potential energy that may be regarded as having been expended will, in each case, be twice these amounts. Hence, if we denote the kinetic energy of the electron in the smallest circle by E, its kinetic energy in the second circle must be $\frac{1}{4}$ E; the potential energy exhausted at this stage being $\frac{1}{2}$ E. Thus, in passing from this second orbit to the first, the electron has gained kinetic energy to the amount of $\frac{3}{4}$ E, while the exhaustion of its potential energy has advanced from $\frac{1}{2}$ E to 2 E, entailing a net loss of energy equal to $\frac{3}{4}$ E. The net loss in passing from any outer orbit to an inner one may be computed by similar means. It is to be noted that the kinetic energy increases from orbit to orbit as we approach the nucleus, and that the energy abstracted by radiation, is energy computed as potential in every case.

(To be continued.)

BRITISH ELECTRICAL EXPORTS IN 1921 AND 1922.

Statistics for the British Empire and Foreign Countries Separately Tabulated.

In our issue of November 30th tabular statements were given showing the imports into Great Britain of foreign electrical goods and machinery, distinguishing the principal countries of origin, in 1921 and 1922. Below are now given, for the same years, statements showing the value of the exports of British electrical goods and machinery, first to the chief foreign markets and secondly to the principal countries of the Empire. The increase or decrease of consumption of any particular class of product in any of the countries given may be seen at a glance.

It will be noticed that the total values in 1921 and 1922 respectively of British electrical goods and apparatus exported to foreign countries were £4,168,000 and £2,782,000, and of those exported to Empire markets £8,872,000 and £4,536,000. Whilst the values in 1921 and 1922 of British turbines and electrical machinery exported to foreign countries were £2,320,000 and £1,981,000, exports to Empire markets amounted to £3,542,000 and £3,340,000 respectively.

TABLE I.—British Electrical Machinery Exports to Foreign Markets (Thousands of £).

	Total to Foreign Markets.		Holland.		Belgium.		France.		Spain.		China.		Japan.		Chile.		Brazil.		Argentina.	
	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922
Steam turbines, &c. ...	687	711	402	436	—	41	1.2	2.3	57	24	26	80	146	71	0.5	—	6	1.7	—	—
Water turbines ...	5	64	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Generators, A.C. ...	145	72	3	1.6	2.9	5.4	15	1.7	8.5	2.6	40	14	—	—	8	1	3.7	10	15	13
Generators, D.C. ...	199	111	17	10	4	13	16	3	9	14	34	12	—	—	5.5	13	5	7	33	14
Motors, traction ...	186	132	—	—	—	—	—	55	—	—	—	—	—	25	—	—	7	18	170	22
Motors, other, A.C. ...	338	207	6.5	1	12	35	19	1.5	60	16	83	64	17	10	13	5	23	12	24	8
Motors, other, D.C. ...	236	118	10	4	11	29	47	11	17	11	41	22	7	5	13	5	14	3.5	13	8.4
Rotary converters ...	74	52	—	—	24	—	9	8	7	—	7	11	3	9	—	—	1	3	16	5
Transformers, static ...	89	56	27	8	10	4	7	3	8	3	9	8	—	—	—	—	0.7	4.6	18	15
Control and switchgear	166	205	8	4	10	5	16	9	17	11	43	44	—	—	3.8	38	12	9	33	39
Magnetos, ignition ...	5	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Other elec. machinery	190	248	6	20	14	18	17	44	12	8	29	35	16	9	12	5	3	12	6	24

Totals:—1921: £2,320,000. 1922: £1,981,000.

TABLE II.—British Electrical Machinery Exports to Empire Markets (Thousands of £).

	Total to Empire.		South African Union.		India.		Straits Settlements.		Hong Kong.		Australia.		New Zealand.		Canada.	
	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922
Steam turbines, &c. ...	419	391	29	50	173	122	—	—	75	16	122	147	6	28	—	2.7
Water turbines	11	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Generators, A.C. ...	314	388	28	18	191	145	—	—	—	—	53	104	5	42	—	—
Generators, D.C. ...	275	348	23	23	148	139	20	4	10	5	15	97	7	45	10	5
Motors, traction ...	9	72	—	6.5	6	12	—	—	—	—	—	7.7	0.6	32	—	9.6
Motors, other, A.C. ...	713	549	64	29	418	364	—	—	—	—	144	109	32	13	—	—
Motors, other, D.C. ...	433	286	48	15	220	172	12	5	8	3	88	42	27	11	6	9
Rotary converters ...	331	303	17	1.5	113	82	—	—	12	17	176	201	—	—	—	—
Transformers, static ...	332	212	29	13	130	80	—	—	—	—	120	86	36	16	—	—
Control and Switchgear	384	451	27	40	201	247	—	—	—	—	134	90	7	40	—	—
Magnetos, Ignition ...	26	13	—	—	6	2	—	—	—	—	13	5	4	2	—	—
Other elec. machinery ...	295	318	43	27	136	126	13	14	12	20	56	85	15	16	2	12

Totals:—1921: £3,542,000. 1922: £3,340,000.

TABLE III.—Exports of British Electrical Goods and Apparatus to Foreign Markets (Thousands of £).

	Total to Foreign Countries.		Holland.		Belgium.		France.		China.		Japan.		Chile.		Brazil.		Argentina.	
	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	1922	1921	
Wires and cables, insulated—																		
Rubber insulated	282	129	19	3	26	7	—	—	26	36	—	—	20	12	23	6	81	19
Insulation other than rubber	694	355	88	19	15	9	5	2	258	88	—	—	126	172	11	9	86	24
Telegraph and telephone ...	325	128	68	8	54	26	2	—	18	15	—	4	—	—	3.5	6.5	71	26
Submarine telegraph and telephone (1)	612	263	—	—	—	—	—	—	—	59	93	65	—	—	45	—	—	—
Wireless instruments (not valves)	97	302	9	12	6	4	5	6	6	12	10	174	—	—	3	14	—	—
Other telegraph and telephone instruments	207	165	5	3	10	8	6	3	13	3	24	62	—	—	8	6	49	44
Other telegraph and telephone apparatus...	730	504	22	13	101	34	35	24	44	17	47	99	61	3	13	21	167	90
Lighting carbons	12	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Furnace carbons	21	16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Other carbons	11	11	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lamps, gasfilled	34	42	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
,, other incandescent ...	60	34	—	—	9	4	11	—	9	5	—	—	4	3	4	4	9	8
Batteries for hand flash lamps	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Batteries, other primary ...	81	31	—	—	1	1.7	—	—	—	—	—	—	—	—	8	4	61	12
Accumulators, portable ...	46	27	2	0.5	—	—	—	—	8	1	—	—	—	—	2	9	13	3
,, stationary ...	53	56	9	5	—	—	—	—	2	8	—	—	3	8	3	2	11	18
Lighting accessories and fittings	252	163	11	7	12	6	29	20	38	27	—	—	8	8	20	17	66	51
Ammeters, voltmeters, &c. ...	67	33	—	—	8	3	12	2	3	6	11	9	—	—	10	3	4	1
House service meters... ...	59	46	—	—	4	—	—	—	14	13	—	—	2.6	5	4	4	11	7.7
Electro-medical apparatus ...	22	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Switchboards, other than telegraph and telephone	56	102	—	—	2.8	5.5	—	—	18	5	2	66	—	—	2	7	13	4
Wireless valves, vacuum and X-ray tubes	—	27	—	—	—	—	—	6	—	—	—	6	—	—	—	—	—	—
Other goods and apparatus ...	394	305	51	26	35	15	36	40	48	22	13	18	18	52	16	12	67	20
Total of electrical goods and apparatus exported to foreign markets (2) ...	4168	2782	295	121	293	133	166	129	515	324	229	518	266	288	185	128	727	340

(1) U.S.A. ... ... 1921 £340,000 ... 1922 £96,000
(2) Spain ... ... 1921 £158,000 ... 1922 £85,000
(2) Norway ... ... 1921 £156,000 ... 1922 £60,000
(2) U.S.A. ... ... 1921 £895,000 ... 1922 £72,000
(2) Sweden ... ... 1921 £93,000 ... 1922 £62,000
(2) Denmark ... ... 1921 £45,000 ... 1922 £91,000

TABLE IV.—Exports of British Electrical Goods and Apparatus to Empire Markets (Thousands of £).

	Total to Empire markets.		South African Union.		India.		Straits Settlements.		Hong Kong.		Australia.		New Zealand.		Canada.	
	1921	1922	1921	1922	1921	1923	1921	1922	1921	1922	1921	1922	1921	1922	1921	1923
Wires and cables, insulated—																
Rubber insulated ...	950	627	101	56	216	173	—	—	34	9.5	402	275	143	57	—	—
Insulation other than rubber ...	1,379	685	225	68	370	324	52	7	66	17	498	183	122	43	1.6	0.6
Telegraph and telephone	1,294	429	30	29	782	95	—	—	—	—	304	188	53	58	—	0.7
Submarine telegraph and telephone ...	1,535	140	—	—	829	3	7	1.7	—	—	—	—	—	—	110	54
Wireless instruments (not valves)	58	75	1.8	2.2	39	54	—	—	—	—	2.5	2.3	—	—	1.3	6
Other telegraph and telephone instruments...	354	345	31	8.3	168	199	16	5.7	—	—	50	39	—	—	—	—
Other telegraph and telephone apparatus ...	606	452	47	21	100	108	38	22	—	—	92	76	26	15	20	61
Lighting carbons ...	8.7	4.4	—	—	4	0.6	—	—	—	—	2.7	1.9	—	—	—	—
Furnace carbons ...	8.9	3.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Other carbons	7.6	8.4	—	—	2	1.8	—	—	—	—	2.9	3.9	—	—	—	—
Lamps, gasfilled ...	103	99	13	12	28	24	—	—	—	—	45	42	4	7	—	—
,, other incandescent	247	188	39	23	70	43	4.8	3	6.6	2.7	87	81	16	18	4	5
Batteries for hand flash lamps	9.7	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Batteries, other primary	83	53	8.7	5	35	18	2.1	2.8	—	—	8.4	7.7	8.8	6.6	—	—
Accumulators, portable	144	74	15	5	100	38	—	—	—	—	11.6	17.7	8.8	7.6	—	—
,, stationary	257	250	15	5	114	120	4	0.3	—	44	97	40	11	3	—	6
Lighting accessories and fittings	545	331	76	34	201	140	20	9	27	9	102	78	44	35	—	—
Ammeters, voltmeters, &c.	193	109	15	10	30	29	—	—	—	—	126	45	12	15	—	—
House service meters ...	131	120	6	7	27	9.7	—	—	4.8	1.5	60	69	16	15	9.7	10
Electro-medical apparat's	56	13	12	2	22	6	—	—	—	—	8	3	5	—	—	—
Switchboards	183	107	6.7	5 4	133	54	6.8	5	11	1.5	12	33	—	—	—	—
Wireless valves, vacuum and X-ray tubes ...	—	13	—	3.1	—	1.2	—	—	—	—	—	2.4	—	—	—	1.4
Other goods and apparat's	690	395	138	49	221	152	34	16	—	—	158	122	36	31	12	10
Total of electrical goods and apparatus exported to Empire markets	8,872	4,536	808	382	3,518	1,612	228	108	194	107	2,079	1,292	522	324	168	187

THE LONDON STUDIO OF THE BRITISH BROADCASTING COMPANY.

A Visit to 2LO.

November 14th, 1923, was the first anniversary of the inauguration of regular broadcast radio telephony by the London station of the British Broadcasting Co., Ltd. During the year, 2LO has transmitted every evening without exception, and without any serious technical hitch—pioneer work that has resulted in achievements of no mean value—and it is pleasant to be able to record that the company's future now seems to be well assured.

To those members of the Institution of Electrical Engineers and the Physical Society of London who visited the Savoy Hill Studio last week, the modern microphone will probably rank as the most outstanding improvement of the year. Some months ago the standard type of instrument at the British stations was superseded by the new pattern illustrated in fig. 1. It is extraordinarily sensitive, a product of Marconi's Wireless Telegraph Co., Ltd., and we believe that Capt. H. J. Round was responsible for its design.

Another notable achievement is the simultaneous broadcasting of one programme from all the transmission stations in the country. When first proposed it was considered by the G.P.O. engineers to be impossible to obtain the necessary conditions to enable the trunk telephone land lines to be utilised for this purpose, but there is no need to point out how well the problem has been solved. Our second illustration is a view of the line terminal apparatus at the 2LO studio, which, incidentally, is the means of users of the ordinary telephone in certain parts of the metropolis being able to listen to concerts sometimes without the aid of radio receivers.

Considering the low power and short waves (which suffer greater absorption) that were used, the measure of success which was attained in the broadcasting of speech and music in both directions across the Atlantic clearly indicates the immense potentialities of this method of communication; and the experiment of relaying American broadcast matter from the London station, with the aid of a 17-valve intermediate station on the South Downs, will be looked forward to with interest. When, however, transatlantic conversation was attempted, "atmospherics" caused trouble, and also (notwithstanding repeated requests to cease operations) much interference was caused by oscillating receivers, particularly in the West of London. Such a state of affairs is to be regretted, and owners of such sets will have no one but themselves to blame if it is found necessary to prevent the recurrence of similar conditions.

Remarkable as the development has been during 12 short months, there are good chances of progressive technical improvement in the future. It will probably not be long before it will become possible to broadcast two separate programmes simultaneously from the same station on different wave lengths, so that listeners can make their choice; and while it is maintained that suppression of echo and reverberation is necessary for the best speech transmission, it is believed that a limited echo is beneficial in the case of the transmission of music. Consequently a new studio is being furnished at Savoy Hill in order that a comparison may be made. The recent increase in the wave lengths used by most of the British stations should also result in improved reception.

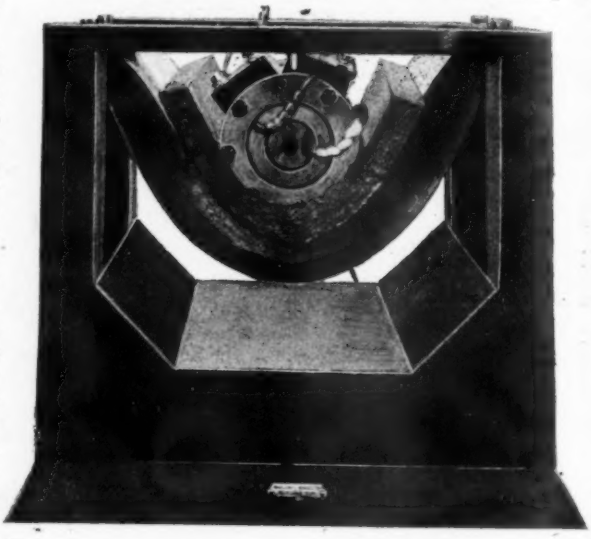


Fig. 1.—The Microphone at 2LO.

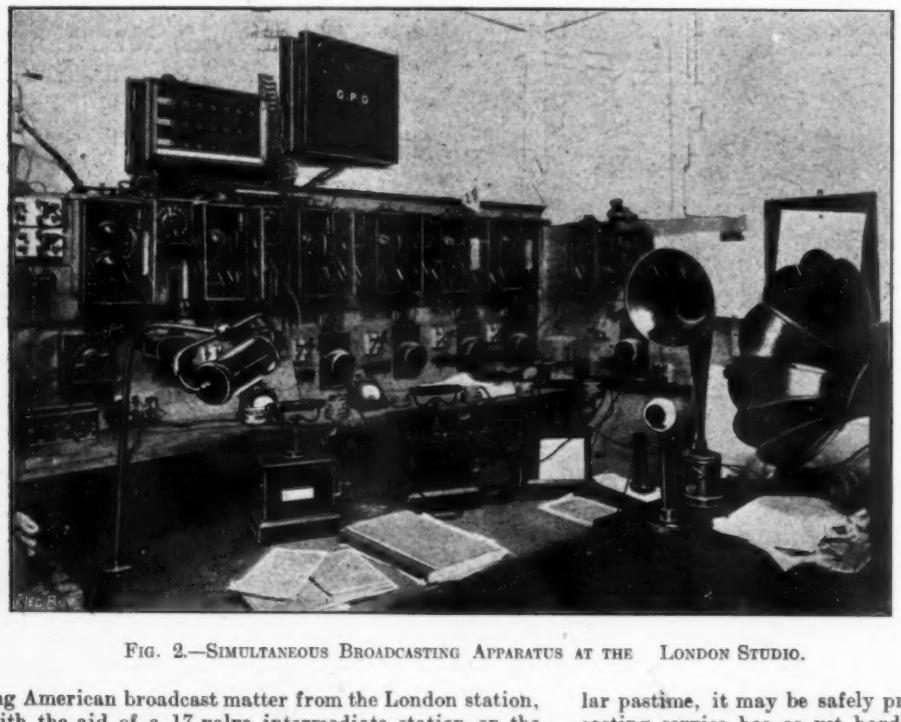


Fig. 2.—Simultaneous Broadcasting Apparatus at the London Studio.

Without entering into the politics that underlie this new and decidedly popular pastime, it may be safely predicted that the broadcasting service has as yet hardly crossed the threshold of its possibilities, and Senator G. Marconi was no idle boaster when he recently said: "... we are paving the way for future developments which may make a striking difference to the world's history."

EXTRA-HIGH-PRESSURE TRANSMISSION LINES.

By R. BORLASE MATTHEWS, Wh.Ex., A.M.Inst.C.E., M.I.E.E., F.R.Ae.S.

(*Continued from page* 852.)

Outdoor Sub-stations.

During recent years the number of these installations has very considerably increased. At the recent Paris High-Pressure Conference, one of the three papers that attracted most attention was that of Messrs. H. W. Young and A. Alsaker, which dealt with American practice in this direction. The authors pointed out that it was necessary to distinguish between (*a*) small capacity step-down stations, and (*b*) large capacity step-up or step-down stations handling and switching heavy loads on important transmission lines. Large-capacity sub-stations, whether of indoor or outdoor type, employ practically the same equipment and connections. The case is, however, different with the small-capacity step-down outdoor stations, and many radical departures have been made from the standard practice of indoor sub-stations. The principal reason for this change in design has been the necessity for reducing constructional costs to a minimum in supplying country districts. This scheme was found to be much more satisfactory than quoting rates per unit greatly in excess of those charged in towns; or making an installation charge to the consumer to cover the capital cost of the equipment. After all, there is great need for the study of psychology in the supply of electricity to the public. Further, as the authors of this particular paper pointed out, there are no municipalities in America which are ready to embark upon expenditures, regardless of income. There, in analysing the soundness of any undertaking, the question is whether or not it would pay a reasonable return on the investment. The amount of new capital available each year for investment is limited, and one of the inherent advantages of privately-owned industry is that its limited amount of capital is automatically apportioned among those industries economically the soundest, where labour can work to the best advantage and secure the best possible compensation. Under any other system of society, a proper apportioning of available capital becomes an extremely difficult problem.

Fig. 1 shows the usual form of indoor station, with a double supply from the high-pressure lines. The equipment includes lightning arresters, automatic oil switches, potential and current transformers, with metering equipment on the high-pressure side. The low-pressure busbars are equipped with automatic oil switches on the outgoing feeders. Further indicating instruments are installed in the transformer circuits and in the feeder circuits, in addition to watt-hour meters. A comparison of fig. 1 with the lay-out in fig. 2 demonstrates clearly the greater simplicity of the modern outdoor sub-station suitable for voltages of 6,600 V and above, and for capacities of from 75 to 3,000 kVA. High-pressure fuses replace the automatic oil switch, and are primarily designed to protect the transformers against short circuits. Overload protection is provided for by an automatic oil switch on the low-pressure side. Lightning protection is secured by the use of choke coils and horn-gap lightning arresters, with limiting resistance in the ground circuit.

Experience in the operation of both types of sub-station has proved that the one is as reliable as the other, in so far as continuity of service is concerned, though the indoor equipment ought really to be the more reliable. The economy to be effected is in the simplified equipment and not in the buildings, since against the latter have to be set off a greater area of land, galvanised steel supports, &c.

The rapid change from indoor to outdoor construction during the past two years—especially in the case of the larger sub-stations—has not been so much due to questions of cost as to the increased safety obtainable with the outdoor station. The rapid growth of central-station systems, with the consequent increase in sustained short-circuit capacity, has made it a dangerous practice to confine electrical failures within a building. Apart from the great danger to operators, the work of restoring the service is greatly hampered in a masonry sub-station. Such vast areas have now to be covered in America—often of 1,500 to 5,000 square miles—that the outdoor station is an economic necessity. According to Mr. Young, the present American practice is to employ as few lightning arresters as possible and to depend upon good insulation of the lines. The transformers are tied solidly to the lines. The American aim now is to maintain a really continuous service whatever fault may take place. American outdoor sub-stations are usually about 20 per cent. cheaper than the indoor type.

Mr. B. Bauer, in discussing this particular paper, pointed out that in Switzerland they eliminated light-

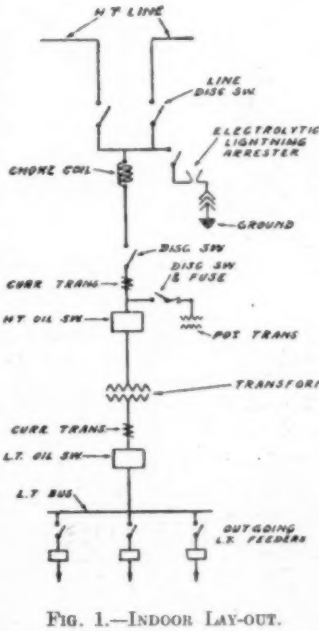


Fig. 1.—Indoor Lay-out.

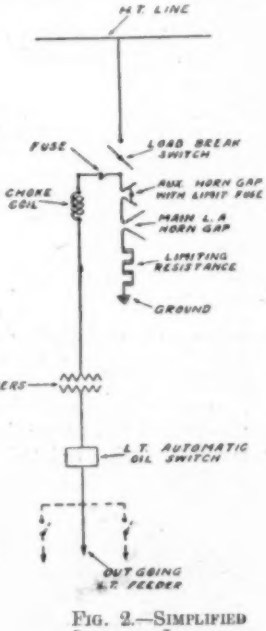


Fig. 2.—Simplified Outdoor Lay-out.

ning arresters with resistances, also choke coils and every device for over-pressure, grounding the neutral. Mr. Young, however, stated that in America they did not care to eliminate the choke coils. While American practice approved of outdoor horn-gaps, in Europe, Mr. E. O. Meyer pointed out, considerable trouble had arisen through the blowing-out of the arc by the wind. Such sudden interruptions were liable to cause dangerous surges to arise.

It has been suggested to the writer that air-insulated sub-station equipment is probably not the last word in sub-station design. It is quite likely that the world may eventually turn to an entirely enclosed system, based on British cable practice. It is to be hoped that some British electrical engineer will bring forward some suggestions along these lines at the next conference, and so give some of the experts something to think over very seriously. At present American, Continental, and British engineers are not sufficiently cognisant of the work that the others are doing. However, the Paris Conference is doing much to eliminate this ignorance.

Oil Circuit-breakers.

Like other high-pressure apparatus, oil circuit-breakers have been considerably developed during the last few years. In a paper by Mr. J. B. MacNeill, it is mentioned that 220,000-volt circuit-breakers are already in use on the West Coast of America, and that there are now many installations where the rupturing capacity of the breaker is 1,500,000 kVA (on a three-pole basis, approximately 60,000 amperes at 15,000 volts).

The terminals of a breaker of this form are of the condenser type, made by winding alternate layers of micarta paper and tinfoil in such a way that the electrostatic stress is distributed over the terminal and the potential gradient through the wall of the terminal is equalised. The tanks are equipped with a fireproof lining, which is also highly insulating. The lever mechanism for actuating the contact is wholly enclosed, so that there are no stuffing boxes through the case, through which oil can be thrown when opening heavy short circuits. A safety valve is provided for excess pressure.

For the higher voltages, the breakers are equipped with high-speed arcing contacts, which are held in adjustment with the stationary contacts until the main moving contacts have got well under way, and are moving at high speed. The high-speed arcing contacts are then unlatched and the rapid opening is very effective in reducing the number of half cycles during which the arc is maintained.

Notwithstanding the great development in size and capacity, the fundamentals of design have remained simple. The usual practice is two breaks per pole, both on the main contacts and on the arcing tips, the contacts at all times being immersed in oil, and the opening operation being assisted by gravity. Steel is employed for all structural parts, and materials of uncertain strength, such as cast-iron, brass, porcelain, &c., are eliminated as far as is practicable. By the use of baffling and muffling devices, it is possible to control the excess pressures incidental to the interruption of short circuits, dissipating the excess pressure without the expulsion of oil or heated gases from the circuit-breaker. Considerable attention has also been given to the safe functioning of the breakers with interconnected apparatus through suitable interlocks to prevent faulty operation due to mistakes of attendants. Further to reduce the possibility of short-circuit between phases in large generating plants, several stations have been built with isolated phases. It is claimed that by locating each phase in a separate room, or on a separate floor, a phase-to-phase short circuit becomes practically impossible.

In the course of the discussion on Mr. MacNeill's paper, it was pointed out that a similar method of separating the phases had been a failure in Germany. This was due to the puncturing of the transformers, as the electric remote control of the switches was not sufficiently simultaneous.

As the power available in the works of the larger manufacturers is inadequate for breaker-testing purposes—even though this amounts to 20,000 kVA—a series of tests have been carried out on the systems of certain power companies. Near Baltimore more than 200 short-circuits of current up to 25,000 amperes at 13,200 volts were thrown on the combined system with practically no ill effect, as far as the system apparatus was concerned, and with only minor interruptions to service. On 25,000 volts the Detroit Edison Co. has made short-circuit tests up to current values of 12,000 amperes. As a result of all these tests, considerable modifications have been made in the design of apparatus.

Towers.

A useful comparative summary was presented by Mr. C. Duval of the methods of design for the foundations of towers, as adopted in various European countries and in America.

A new form of articulated flexible tower suitable for a 220,000-volt line, was described by Messrs. G. Darrieus and H. Desbarres. Flexible towers were employed in America over twelve years ago. They were considered also for the proposed big-span line from Norway, *viâ* Sweden, to Denmark across the sea. However, the net saving only amounted to a few per cent. on the whole cost of the installation, and hence it was felt that it was preferable to employ the rigid type. Incidentally, the span across the navigable channel of the Sound for this proposed line is 2.3 kilometres (say 1½ miles), and at its lowest point it must be well clear of the tallest masts of any ship.

A description was given by Mr. R. Norsa of the 900 metres (say 3,000 feet) 130-kilovolt, six-conductor line across the Pô, at Plaisance in Italy. If steel wire had been used for this line, the loss would have been 90 kW; so a steel core of 109 mm.² section was employed, with an aluminium coating of 10 mm.², which reduced the loss to one-seventh.

(To be continued.)

ELECTRICITY IN MINING.

(Continued from page 847.)

3.—Other Accidents Due to Electricity.

Although it has not been the practice to refer in detail to such accidents, many useful lessons may be learned by studying the circumstances of such minor mishaps as come to the notice of H.M. Inspectors of Mines. With a view to recording the deductions arrived at, and disseminating the information obtained, the Inspector has a few remarks to offer under this heading.

It is observed by way of preliminary, that whereas it is a requirement of Section 80 (1) (iii) of the Coal Mines Act, 1911, that all accidents caused by electricity which result in personal injury shall be duly reported, there is no obligation to notify the Inspectorate of electrical accidents, or dangerous occurrences, which fortunately have not resulted in personal injury, except ignitions of firedamp or coal dust below ground, or underground fires, or overwinding while men are in the cage. These three special classes of accidents are reportable by virtue of an Order (No. 934, December 22nd, 1906) made by the Secretary of State under the provisions of Section 81 (i) of the Coal Mines Act. Although in some instances notification is received of electrical accidents, the reporting of which is not obligatory, this is not the universal practice.

Any particular accident may, fortunately, cause no personal injury, but an expert investigation of the circumstances may bring to light inherent defects of design or manipulation, and the necessary steps can then be taken to introduce remedies, or to issue warnings, or to give advice applicable not only to the mine in question, but to others in like circumstances.

For the purpose of this report these accidents are grouped under four headings, as follows:—

(*a*) Faults of design or construction, including unsuitability for the partieular service:—13 accidents.

(*b*) Defects of maintenance:—8 accidents.

(c) Misuse, negligence, ignorance, and meddling:—7 accidents.

(*d*) Normal risks, *i.e.*, considered unforeseeable:—12 accidents.

The allocation is necessarily approximate, and is admittedly a matter of personal opinion, but it will serve to show that a large proportion may be classed as avoidable accidents. Of the 14 surface accidents, six are classed as due, in part at any rate, to faults of design or construction. Three of these occurred in connection

with switchboards and their appurtenances, and three in connection with pole lines and other open wiring.

While it is but fair to admit that collieries have been passing through very difficult times, and while it is acknowledged that serious efforts have been made to remodel the electrical equipment above ground, where necessary, to bring it into compliance with the regulations which were introduced in the summer of 1920, there yet remains to be done a considerable amount of work. Many old-fashioned open-type switchboards do not include facilities for piecemeal isolation so as to enable routine cleaning and minor repairs to be carried out, and do not in their design sufficiently protect the operator from accidental contact or short-circuits and blowing fuses. The requisite alterations demand time and opportunity, and call for the exercise of considerable ingenuity in some instances; but the alternative of complete replacement entails serious expense, so that the effort is well warranted. A number of accidents, both above and below ground, indicate failure to appreciate the importance and value of systematic testing, by which incipient defects may be discovered and remedied before an accident supervenes with resulting loss of time and disorganisation of work. Electrical circuits have a peculiar advantage in the ease with which searching tests may be applied, and hidden defects may be precisely located. Trailing cables and connectors were involved in 10 accidents underground. These details are inevitably subjected to rough usage, and their manipulation is largely in the hands of men who lack electrical knowledge; but these facts make it all the more necessary that there shall be regular and frequent expert examination, supported by searching tests, so devised as to discover hidden injury or incipient defects. Repairs of trailing cables are particularly difficult to carry out unless both trained labour and the necessary appliances are available. Such cables are usually insulated with vulcanised rubber, and sheathed with a special class of rubber compound. Effective repair of the dielectric and of the sheathing cannot be made by means of ordinary adhesive or fibrous tapes, and cannot be properly completed without vulcanising the joint after the application of suitable rubber tubes. Unless facilities exist at the colliery, sufficient spare cable should be provided to permit damaged cables to be sent to the manufacturer for repair.

Concluding this part of his report, the Inspector refers to two cases of explosions of switchgear.

These explosions had no connection with the presence of inflammable pit gas, but had their seat in the switchgear itself. In one case an oil-immersed circuit-breaker exploded, fortunately without causing personal injury, owing to an internal defect, coupled with, or aggravated by, the misuse of the switch which was used to break the circuit repeatedly at brief intervals, in order to facilitate putting on a new haulage rope.

Explosive gas may be generated by the "cracking" of the oil under the influence of the electric arc, or break-flash, at the switch contacts. Generally, this gas is produced in small quantity and escapes harmlessly, but under conditions approximating to a continuous arc, there may be an accumulation which is ultimately fired by the break-flash.

There is no great difficulty in designing the enclosing switch case to resist such a gas explosion without damage or danger, but unless the live parts of the switch above the oil level are effectively protected, there may be, as a result, a short-circuit in the air space. If the power available from the source of supply is large, the short-circuit may take the form of an explosion of so violent a nature as to destroy a containing case which is quite able to resist the force of a gas explosion.

In the other instance there was no misapplication of the switch, but investigation showed that repairs of the switch contacts had been imperfectly carried out. It appears probable that there was a preliminary ignition of oil-gas, followed by an electrical short-circuit on the unscreened live parts above the oil level. The cast-iron enclosing case was fractured, and glass from the inspection window, which was blown out, caused a slight personal injury to the attendant.

This matter of short-circuit explosions is becoming of greater importance now that so many collieries either take a bulk supply from an outside source, or have installed generating plant of large capacity. In the days when the plant ran to a few hundred kilowatts only, the amount of energy that might be liberated at a short-circuit was insufficient to produce serious explosive phenomena, but the increase in the size of plant makes it necessary for the engineers responsible to reconsider not only the structural features of the switchgear, but the cognate question of the automatic protective devices employed to cut off the power on the occurrence of a fault.

(To be concluded.)

SWITCHES "BACKED-ON."

(Communicated.)

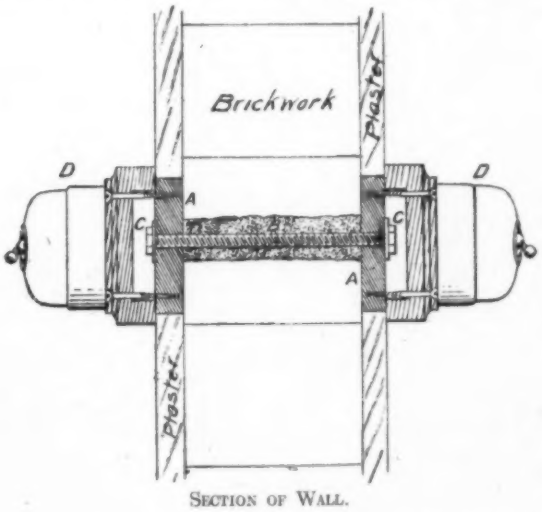
Few things on a lighting installation have a worse effect than to see the switches, after a few months' use, hanging on the wires with a dilapidated wood plug showing, in a halo of crumbling plaster, behind the block.

Much might be said of the merits of differently shaped plugs—and the different walls in which they have to find a fixing—but this article deals with a particular case in which the writer found great difficulty until he hit upon a device (possibly familiar to some) which he has never yet found to fail.

When two switches are back-to-back on a wall, it is obvious that, however carefully the holes are cut each side for the respective plugs, the brick is apt to be split, and one or both of the switch blocks will eventually work loose. If one switch is fed from the opposite side, so that the cable has to pass through a hole in the wall, the plugging is even more difficult.

The system used by the writer is to cut two small strips of wood the thickness of the plaster and not quite the width of the wood block. These are drilled with ¼-in. holes through the centre.

A hole is drilled through the wall and a length of 2 B.A. tapped brass rod (such as is used for wireless) put through it, and the pieces of wood are threaded on each end. (See A and B on drawing.) The plaster is



Section of Wall.

cut away to let these in, and they are tightened down by washers and nuts on the tapped rod C. Any spare rod left protruding can be cut off with a hack-saw or file, and the result will be two firm fixings for the switch blocks which will hold as long as the wall stands.

Any leads from one switch to the other can come through the same hole as the tapped rod and around the side of the wood fixings without injury.

It will be found that this method of fixing takes little if any longer than plugging, and costs only 3d. for the rod and nuts.

SOME ELECTION RESULTS.

The following are some of the results of the General Election:—

Sir Allan Smith, who resigned the chairmanship of the Industrial Group in the House of Commons because he could not support Mr. Baldwin's policy, stood for a Scottish constituency, and was defeated by a Labour candidate.

Sir Edward Manville, who succeeded Sir Allan Smith as chairman of the group, was defeated at Coventry by a Labour candidate.

Mr. P. J. Pybus (managing director of the English Electric Co., Ltd.), who stood as Liberal Free Trade candidate for Shipley (Yorkshire, West Riding), was defeated by a Labour candidate.

Sir Philip Dawson, who stood again for Lewisham as Unionist, was returned by a majority of 439, as against a majority of 7,747 at the previous election.

Sir Alexander Richardson, Unionist, was defeated by a Labour candidate at Gravesend.

Mr. G. Balfour was re-elected as a Unionist at Hampstead.

Sir G. Croydon Marks was re-elected Liberal member for the Northern Division of Cornwall.

Mr. V. G. Crittall, of the Crittall Manufacturing Co., stood as a Labour candidate for the Maldon Division of Essex, and won by 49 votes over the Unionist candidate.

Sir J. S. Harmood-Banner (a director of British Insulated & Helsby Cables, Ltd.) was re-elected Unionist member for Everton (Liverpool).

Ald. J. P. Burman, chairman of the Birmingham Electricity Committee, was elected Unionist member for Duddeston (Birmingham).

Major A. G. Church, secretary of the National Union of Scientific Workers, standing as a Labour candidate, won the seat from the Unionist party at Leyton (East Division).

Mr. E. D. Simon (H. Simon, Ltd., engineers, of Manchester) stood as Liberal candidate for Withington, Manchester, and defeated the Unionist member.

Sir Herbert Austin (Austin Motor Co., Ltd.) was re-elected Unionist member for the King's Norton Division of Birmingham.

Sir William Bull, a director of Messrs. Siemens Bros. and Co., Ltd., was re-elected Unionist member for South Hammersmith (Southern Division), with a greatly-reduced majority.

The political situation arising as a result of the Election was discussed by the Cabinet on Tuesday. It was decided that the correct course to pursue was for Mr. Baldwin and his Ministers to continue in office and meet Parliament, which, accordingly, will reassemble on January 8th, as already arranged.

THE USE OF EXPLOSION POTS ON OIL-CIRCUIT BREAKERS.

(Communicated.)

The ever-growing capacity of power stations and interconnected supply systems necessitates the use of oil circuit-breakers of very large rupturing capacity, and merely increasing the dimensions of satisfactory breakers of average breaking capacity is not sufficient to ensure satisfactory operation.

The failure of oil circuit-breakers is probably most commonly due to bursting of the tanks, owing to the pressure generated on breaking short-circuit current, and to ignition of the gases formed. The obvious remedy is to increase the strength of the tanks, and the head of oil above the point of break, so that the hot gases in passing through the oil are cooled below the ignition point. These methods result in considerably increasing the dimensions and cost of the circuit breaker.

A method adopted comparatively recently in America, and to a less extent in Europe, is the provision of "explosion pots" round the region of arcing and greatest pressure. An explosion pot consists of a strong steel chamber mounted around the fixed contacts, and provided with an aperture, generally at the bottom, through which the moving contact passes. When the breaker operates, the arc is drawn within the chamber, and since the moving contact almost closes the aperture, the pressure generated is released comparatively slowly, and the stress is more evenly distributed throughout the main tank. As the moving contact passes out of the chamber the oil within is forced into the region of arcing by the pressure of the imprisoned gases, and thus the arc is rapidly cooled and extinguished.

It has been suggested that the moving contact should be in the form of a tube, the lower aperture of the tube being uncovered as the contact begins to leave the chamber; in this position the oil can escape through the tube, and in so doing passes right through the arc, which is thus cooled and quenched.

The gases generated cannot rise directly to the space above the oil, but issue through the aperture at the bottom of the chamber, and thence rise through a considerable head of oil, the possibility of ignition of the gases being thereby reduced.

Since the moving contact is a fairly close fit in the aperture of the chamber, the pressure of the gases generated tends to force this contact out of the chamber, and thus the speed of break is accelerated.

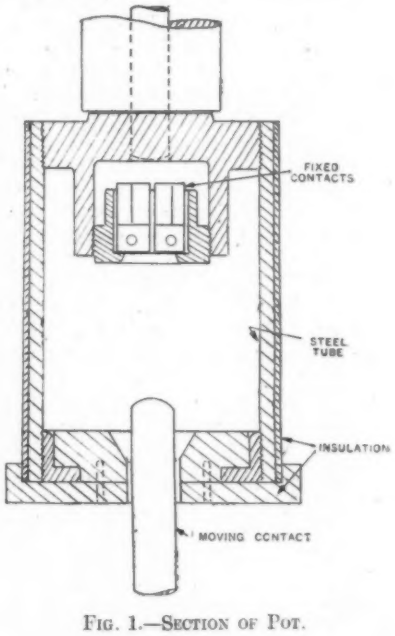


Fig. 1.—Section of Pot.

For heavy currents only the arcing contacts need be placed within the chamber, the main contacts being mounted outside and arranged to make contact after, and to break before, the arcing contacts.

Some results of tests made by the Rand Electric Power Co. were recently published (*Electrical World*, July 28th, 1923). Due to the growth of the generating plant capacity, some existing oil circuit-breakers were giving trouble by failing to clear "shorts" satisfactorily, and one of these breakers was fitted with explosion pots similar to that illustrated in fig. 1, and tested. The results showed that the arc was extinguished more quickly, and the performance of the breaker was improved generally. Oscillograph records showed that the arc was broken as the moving contact passed across the aperture in the base of the pot, in which position the oil in the pot was directed into the arc.

These results were confirmed by tests made by the General Electric Co. (of America). Oil circuit-breakers with and without explosion pots, but otherwise similar, were tested under as nearly as possible identical conditions. The breaker not fitted with explosion pots showed

signs of stress and threw considerable quantities of oil on breaking 5,000 amps., whereas the breaker fitted with explosion pots broke 10,000 amps. without damage.

Oscillograph records showed that at 5,000 amps. the duration of the arc in the plain oil circuit-breaker was more than twice that in the breaker fitted with explosion pots.

Explosion pots may be fitted either to increase the breaking capacity of an oil circuit-breaker or to increase the factor of safety by reducing the pressure in the tanks, and the possibility of ignition of the gases generated on breaking heavy currents. Since satisfactory designs of circuit-breakers for moderate breaking capacity exist, the use of explosion pots will probably be confined to oil circuit-breakers having a rupturing capacity of, say, more than 200,000 kVA.

RUSSIAN ELECTRICAL NOTES.

Battery Locomotives.—The English trading agent in Moscow is reported to have tendered to the Soviet authorities an invitation from the British Mining Association for Russia to participate in an international competition for the best battery locomotive.

The Production of Lamps.—It is stated that the production of lamps at the factories of the Central Electrical Trust is constantly increasing. Some 10,000 lamps per day are being turned out at the new Elokobska works, where further development is being hampered through the delay in receiving automatic devices from abroad.

Baku Tramways.—The Central Electrical Trust has now completed the construction and equipment of electric tramways at Baku, where the formal inauguration of traffic is to take place in the middle of December. The trust is also reported to have received an order for the supply of 300 tramcar motors of a new type for the Moscow tramways.

The Electro Credit Concern.—The Electro Credit Company, which was formed a year ago to assist in the financing of local electrical undertakings of small dimensions, reports having granted loans amounting to 380,000 gold roubles during the present year, and borrowers are said to have already begun to repay a portion of the money. In addition the company has sold goods of the value of 500,000 roubles, and it had stocks of two-thirds this value on November 1st. The net profit realised on all transactions during the year is said to have been 58,000 roubles.

Turbo-generators for Omsk.—A company has been formed at Omsk, in the province of that name, to take over two 1,500-kW turbo-generators which are being built by the Petrograd Electric Machine Trust for the local station at Omsk, which is at present extremely limited in its scope. A third generator of 750 kW is proposed to be supplied by the Volta Works at Varanche (Ural). The two larger machines are to be delivered and set in operation next autumn, while the smaller will be ready at an earlier date.

Stagnation in Sales.—A condition of stagnation is reported to have come over the market for electrical manufactures, and the trusts, institutions and undertakings have reduced their orders. The causes are to be found in the financial crisis which has forced customers to restrain from purchases of manufactures and materials even at reduced prices, and the advent of the lighting season has not improved matters in this direction. As an illustration of the falling off in the demand, it is mentioned that the turnover of the Moscow department of the Central Electrical Trust, which amounted to 1,100,000 roubles in August, declined to 800,000 roubles in September and further to 700,000 roubles in October. Similarly the turnover of the Electric Machine Trust of Petrograd is showing decreasing results.

New Customs Tariff.—It is proposed to introduce a new Customs tariff. At a recent meeting of the Commission entrusted with the examination of the problem it was pointed out to be necessary for the import duties on electric generators of over 5,000-kW capacity to be reduced. The State Planning Commission has approved the proposal for a reduction of the tariff on the imports of articles needed for electrical construction.

Reorganisation of the Trusts.—A special commission of the Government for some time past has been engaged on an examination of the situation of the State trusts with a view to effecting economies in the working of these combinations of industrial works. The turn of the electrical industry has now arrived, and on November 24th a sub-committee of the special commission had under consideration the position of the Central Electrical Trust. The question was raised of removing the work of production of cables from this trust and transferring it to the cable works of the Glavtsvetmeta and the Northern cable works on the ground that these are better equipped than the Central Trust, and are less actively employed. In protesting against such a transfer, the representatives of the trust pointed out that if their cable factory were simply set aside and merely conserved it would involve the discharge of 1,600 workmen, most of whom were skilled men, and the first result would be delays in the execution of seasonal orders as, for instance, armoured cables and special manufactures. The stoppage of the Moscow cable factory would involve an expenditure of 750,000 roubles in the first year, and about 500,000 roubles in the following years, whereas the closing of the cable department of the Glavtsvetmeta would only entail insignificant expenses. Both of the cable factories had a dominating significance both from an economic and a productive point of view; the existence of the trust as an economic organisation would be absurd without the factory. The sale of cable manufactures yielded a large profit which served to maintain the works for the construction of machines, &c., and in that manner the development of the electrical industry was carried on at the expense of the cable works in question. The representatives of the trust stated that if the factory were closed it would be necessary to ask for a grant of 2,000,000 gold roubles from the State.

The position of the Telephone and Telegraph Trust (Weak Current Trust) engaged the attention of the Central Commission on Trusts on the same day. It was explained that in the quarter ended with last September, the work carried out only represented 29 per cent. of the technical capacity, but the situation improved in the December quarter. Nevertheless, it was stated that only one of the works—the Nischigorod radio apparatus works—was being operated at a loss. In the end the Central Commission decided that two of the seven works belonging to the trust should be closed.

The Accumulator Trust, which comprises the Tudor, the Tem, and the Reks works, was then considered by the Central Commission. It was stated that these works were but slightly occupied, the result being that the costs of producing accumulators were from 171 to 283 per cent. higher than the pre-war rates, and were showing a tendency further to increase. The Commission resolved to close the Reks works, leaving the other two working.

High Cost of Production.—Some striking figures have been issued officially in Moscow as a result of an inquiry into the working of the Central Electrical Trust and the Electrical Machine Trust during the first nine months of the current year. The combined output of the two trusts on the basis of the price lists which prevailed in 1914 amounted to 1,678,000 gold roubles, of which 58 per cent. was produced by the Central Trust and 42 per cent. by the other. A total of 60 per cent. of the aggregate production was turned out by the cable works, 20 per cent. by the machine construction works, 17 per cent. by the lamp factories, and 3 per cent. by the works producing accessory apparatus. As compared with the pre-war period and expressed in chervonetz (gold) roubles, the costs of production are stated to have increased by from 200 to 280 per cent. in the case of the construction of machines, by from 128 to 140 per cent. in that of cables, by 123 per cent. in that of lamps, and by 3 per cent. in that of carbons. The increased cost of materials and of wages, unprofitable expenses, and incomplete activity, are given as reasons for the greater cost. A large deficit is expected to arise in the execution of the production programme fixed for the year 1923-24, and this will have to be met by the State grant of long-term credits.

Foreign Boiler Orders.—It appears from a report of a recent sitting of the Supreme Council of National Economy that 26 boilers have been ordered abroad for the Schatur station, the Krasni Oktaber station, and two other stations. As the boilers are required to be equipped with a special kind of furnace invented by M. Makareff, the question arose whether these furnaces could not be constructed at Russian works. In the end, the Council decided to confirm the placing of the orders abroad, the foreign makers having agreed to construct the furnaces according to the instructions of the inventor, who has left Russia to supervise the work. In the meantime the Council has emphasised the necessity for attention being paid to the development of the production of the type of furnace in question at Russian works.

Reduction of Estimates.—The Electrical Planning Commission has raised a protest against the intention of the National Financial Commission to reduce the estimate for the Schatur station from 6,750,000 gold roubles to 4,700,000 gold roubles. It is considered that if this decision is maintained the result will be to delay for one year the starting of the station, and interfere with the supply of current to Moscow, disarrange the contract given for machinery to the Witkowitz works in Czecho-Slovakia, and cause financial losses owing to the inability to meet the needs of customers. One 16,000-kW generator is required to be on load next year, and the second of the same size in the winter of 1925.

Electrification of Rural Industries.—The Rural Construction Office for the electrification of rural industries is to be converted into a company with the participation of State organisations and of private and foreign capital. The initial capital is to be 2,000,000 gold roubles, and one of the largest electrical firms in Sweden is said to have made a definite offer to become one of the original members.

LEGAL.

Workmen's Compensation Claim.

A sequel to a fatal accident which occurred at the Corporation's electricity works last July, was heard at Plymouth County Court, on December 4th, when application was made for a declaration that the widow was the sole dependant of the deceased workman, James H. Hosking. It was explained that a sum of £300 had been paid into court as compensation by the Plymouth Corporation, but they had addressed the notice to the widow and a stepson, joining them as dependents. The latter, however, did not desire any of the money. The judge granted the declaration asked for, and made an order for the payment to Mrs. Hoskings of £15 forthwith, and the balance at 30s. per week.

British Thomson-Houston Co., Ltd., v. British Insulated and Helsby Cables, Ltd.

(*Continued from* p. 879).

On November 30th, having been cross-examined with the object of proving that tungsten behaved differently from other metals, Mr. Ballantyne, in re-examination, maintained that given an appropriate temperature, worked tungsten fell more or less into line with ordinary metals.

Further evidence was given by Mr. Augustus Charles Hyde, managing director of the Vactite Wire Co., Ltd., of Acton (which manufactures accessories for electric lamp makers), and a director of the Ferrox Co., Ltd., and the Ferro-Arc Co., Ltd. He stated that he had experience of drawing many kinds of wire, and the processes used by his firm were common to the trade, and not secret. Cross-examined, witness admitted that he was not a lamp maker and had never made a tungsten lamp. He had never treated tungsten for the purpose of lamps.

For the convenience of Counsel, the hearing was not resumed on December 3rd. On the 4th, evidence was given by Mr. John Vincent Pletts, a Member of the Institution of Electrical Engineers, the Institute of Physics, and the Institution of Mechanical Engineers, and a Fellow of the Institute of Chartered Patent Agents. He stated that he was familiar with finished tungsten, but not with its manufacture until the present year. He considered that the 1906 specification described an invention for working tungsten hot, and for making use of its ductility while hot. There was sufficient description of the invention to enable it to be carried into effect. He had followed what he understood to be the instructions, and had drawn tungsten wire by that method. Cross-examined, he said he had no detailed knowledge of the steps of drawing or working the metal before the date of that litigation.

Mr. Hunter Gray: In the process of manufacture you find nothing in the 1906 specification of value at all, except that you are to work tungsten hot, and a method of making the tungsten?—Yes, and a method of working it hot, and it is stated that it is ductile when hot.

You said there was nothing more new in the process?—No.

What you are told in the way of details of the process results in a failure?—I think not.

Mr. Innes William Aldridge, assistant superintendent of the defendants' wire mills at Prescot, said that they were some of the largest wire-drawing mills in the country, and the metals drawn were chiefly copper, bronze, and aluminium.

Dr. Oberlander was recalled, and the evidence was concluded.

On December 6th, replying on behalf of plaintiffs, Sir Arthur Colefax submitted that both the 1906 and the 1909 specifications must be read in the light of the discovery to which each of them referred, and must be the basis of any process. It was important to get a clear conception of the discovery stated to have been made in each document, in order to appreciate rightly how different they were. One discovery was that by heating alone remarkable molecular changes were produced, which gave to tungsten when hot a ductility comparable with that of other ductile metals, whereas the 1919 specification described quite a different discovery, which was that if they obtained a sufficient temperature permitting the working of tungsten they induced a fibrous state, and with it ductility.

At the conclusion of Counsels' speeches, on December 7th, his Lordship said that he would digest the evidence and give judgment at some future date—he could not say when.

The hearing occupied 18 days.

Times Electric Co., Ltd., v. E. & E. Gates, Ltd.

In the Mayor's and City of London Court, on December 7th, before Judge Shewell Cooper, the plaintiffs claimed £10 from defendants on account of the supply of electric fans. The defendants raised a plea of late delivery, and incorrectness of design. In reply to this, plaintiffs said that they had relied upon the maker's rating as being correct, and although they had supplied similar fans in the same district, no complaints had been received from other customers. They further stated that the four fans in question were returned to them in a damaged condition.

In giving his decision, the Judge said that although the defendants were justified in rejecting the goods, they had waived that right and dealt with the goods. Inasmuch as the sale was by description he held that the goods supplied by the plaintiffs answered the description. He therefore gave judgment for the plaintiffs for £10.

Electric Lamp and Supply Co., Ltd., v. T. Kelly and N. Tarshis.

In the Shoreditch County Court, on Tuesday, before Judge Cluer, the Electric Lamp & Supplies Co., Ltd., of 73, Newman Street, W., sued Thos. Kelly and Nat. Tarshis, formerly trading as Messrs. Kelly & Tarshis, of 5, High Street, Shoreditch, electricians, to recover £44 17s. for cable supplied in March. There was a counterclaim by the defendants, in which they stated that they ordered 15 miles of cable, 10 miles of 1/18 at £5 12s., and 5 miles at £10 a mile, which the plaintiffs did not deliver. They had sold the cable at £7 1s. 5d. and £12 5s. respectively, and owing to the non-delivery they had to purchase it in the open market at £8 4s. and £12; the loss to them exceeded the plaintiffs' claim and they counterclaimed £50.

Mr. Willis appeared as counsel for the plaintiffs and Mr. E. H. Coumbe, barrister, for the defence.

When the case was called on Mr. Coumbe applied for an adjournment owing to Mr. Kelly being ill. Mr. Willis objected on the ground that on November 8th, when the case was first down for hearing, both the defendants were ill in bed. This was a case where his clients were being kept out of £44 odd, to which there appeared to be no defence.

Judge Cluer: I agree there appears to be no defence to the claim but there is the counterclaim, and if only 14 miles 1,125 yards were supplied of course the counterclaim is good. The plaintiffs had better have their judgment and a day can be definitely fixed for the counterclaim.

Mr. Willis: I will not labour the point if a definite date is fixed and the costs are paid.

Judge Cluer: Very well. Of course the defendants must pay all the costs, as they have brought you here.

REVIEWS.

Mechanical Road Transport. By Charles Guthrie Conradi, M.I.M.E. Pp. xviii+394; figs. 188. London: Macdonald and Evans. Price 21s. net.

This is one of the "Reconstructive Technical Series," edited by Mr. G. W. de Tunzelman. It claims to meet the requirements of readers who may be described generally as users and potential users of mechanically-propelled road vehicles, and the claim is well grounded. It is of a practical character, and shows throughout that it is based on practical experience.

The detailed descriptions of vehicles and their parts are well adapted to guide users in the choice and working of such vehicles and their accessories.

The author gives much fuller information about electric vehicles and vehicle batteries than is usual in books on mechanical transport. He clearly believes and gives reasons for his belief, that battery vehicles deserve much wider use than yet obtains, as they are more economical for many kinds of service than any of their rivals. The information on both lead and iron-nickel batteries is much fuller than usual, their relative merits are set out impartially, and the proper treatment for economical maintenance is made quite clear. The only omission which the reviewer has noticed in this respect is that the effect of low temperature on the e.m.f. of iron-nickel batteries is not mentioned. A word of advice to users on this point would not be amiss.

Excepting for two chapters on tramways and 'buses, the book deals only with vehicles for the transport of commodities and for certain special purposes, mainly municipal, with some reference to ancillary matters.

The first two, and the fourth and fifth chapters, deal with general principles governing road traction, road resistances, power required for traction, and fuels. Why the chapter on horse traction was intercalated as the third instead of in a more logical sequence is a question.

These four chapters are very well done. They set out the general principles governing road traction in a clear and concise fashion, which will enlighten readers on subjects which some transport experts seem to be foggy about.

Throughout the author keeps steadily in view the connection between these general principles, the design of vehicles, and economical transport methods.

A very useful chapter is that on "Labour and Time-saving Devices," for warehouses, factories, depôts, &c.; trucks, conveyors, containers, &c.—very great aids to the economical utilisation of road transport, as well as to the internal movement of materials.

The chapter on working costs deserves careful study by

users of commercial vehicles, both small and great. The importance of recording costs is strongly urged, and suitable forms, well-designed to facilitate comparison and supervision, are illustrated with filled-in examples. A somewhat unusual method of reckoning depreciation and interest charges is advocated on pp. 240/242, which will not meet with the approval of accountants. Briefly, it takes both depreciation and interest at fixed percentages, but charges both on the depreciated value year by year. This puts a very heavy charge on the first year, *e.g.*, 38.5 per cent. on a five-year life, with 6 per cent. interest, and does not provide that rate on the original capital throughout, though it does provide—with the help of the scrap value—for replacement at the end of the life. It seems sounder and more convenient to use an equated regular annual charge to cover the two items, including interest on the original investment.

The chapter on "Driving Instructions" is of great value, and may open the eyes of some users, as well as their drivers.

The chapter on tires gives a good deal of information about the construction of these essential parts, and intelligent guidance to their choice for various services. It will surprise some to hear that a tire—like a battery—may be irretrievably damaged by a single overload.

No fewer than 18 appendices set out the law relating to motor transport, from the Carriers' Act of 1830; Statutory Rules and Orders; British Standard Specifications, &c., &c.; a useful reference and handbook in themselves.

The illustrations are generally clear and informative, many of them printed as plates on art paper, with the disadvantage in some cases that they are inconveniently separated from the relevant text. The printing and general get-up is good. The book can be thoroughly recommended; even designers and makers of commercial motor vehicles will find some useful tips in it.

Principles and Practice of Wireless Transmission. By G. Parr. Pp. 163; figs. 21. London: Ernest Benn, Ltd. Price 5s. net.

Mr. G. Parr is demonstrator in electrical engineering at the Finsbury Technical College, where Dr. W. H. Eccles keeps etheric enthusiasm at a high pitch.

The great mass of amateur experimenters are engrossed in receiving circuits, and for these experimenters there is an unceasing flow of literature, but it is far otherwise for the small band of transmitting enthusiasts, who will welcome this book, as it sets out simply and concisely the principles of wireless transmission.

The first three chapters deal with currents, inductance and capacity, the remaining six with wave motion and the various methods of telegraphic and telephonic transmission. The reader requires no previous knowledge of electrical phenomena, and only a very elementary knowldge of mathematics, for a complete understanding of the book. The author, in fact, states that "mathematical treatment, which is apt to irritate the non-technical reader, has been avoided wherever possible," and in the next edition he might possibly reduce the number of split infinitives, as these, too, are apt to irritate non-technical readers, and at the same time increase the number of diagrams, as these greatly assist non-technical readers.

This is a book which can be recommended to all those amateurs who are turning their attention to transmitting experiments, as well as to those receiving experimenters who wish to have an intelligent grasp of what goes on at the other end.

Popular Fallacies Explained and Corrected. By A. S. E. Ackermann, B.Sc. (Third edition.) Pp. xvi+984. London: Old Westminster Press. Price 12s. 6d. net.

It is fourteen years since the second edition of this work was published. The new edition bears excellent testimony to the industry of the author in the interval, for the volume is now almost three times the size of the last edition.

It is a dangerous work for a busy man to take up, for the reader is impelled onward from fallacy to fallacy, becoming more engrossed at each step. Even the most erudite will receive shocks from a study of the work. The author ruthlessly tears up many deeply-rooted illusions which appeared to be grounded in scientific fact. This is accomplished in a very fascinating manner, with copious quotations from authorities upon each subject. The 1,350 fallacies which are thus exposed are arranged in 25 groups, with an excellent index, and cover a surprisingly wide field—engineering, physical science, natural history, geography, music, statistics, food, medicine, &c.

The reader may be somewhat discouraged by the first section, which explodes "domestic" fallacies, as many of these would appear to be unworthy of serious attention ("That cocoa is made from cocoanuts," "that sugar is made from bullock's blood," &c.); it is unlikely that the holders of such notions would invest in a book of this kind. However, if these are successfully got through, a wealth of interesting and instructive information is to be found. The engineering and science section is of particular value, although the refutation of the idea that gas engines are for making gas recalls the case of the toper, who, labouring under a somewhat different confusion of terms, inveighed against the use of beer engines. Some of the fallacies, too, appear to have got into the wrong section. Among the electrical items which appear in this division is a statement that electric lamps do not explode; due to external pressure they "inplode." Another fallacy refuted is that there is no water power of any value in Great Britain; the falsity of this, of course, has been amply demonstrated in recent years.

It is not possible to convey an adequate idea of the contents of the volume without quoting each fallacy dealt with. Suffice it to say that the book is well worth buying, and that the author is to be praised for having found time between his various other activities to collect such a mass of information.

The Elementary Principles of Lighting and Photometry. By John W. T. Walsh, M.A. Pp. vi+220; figs. 85. London: Methuen & Co., Ltd. Price 10s. 6d. net.

To write that this book is one of the best in the English language dealing with its subject from a technical point of view is merely to state the truth; nevertheless, its technicality is by no means laboured, so that it may be devoured with interest by those whose training or knowledge is perhaps limited. It is scarcely necessary to state that the author is a senior member of the staff of the National Physical Laboratory, but all may not know that he is a member of the National Illumination Committee of Great Britain, and also general secretary of the International Committee on Illumination, so that it may be realised that he is probably one of the best equipped individuals in this country to place before us a book on the subject with which he deals.

As stated in the preface, the work aims at providing a brief and simple guide to the solution of problems most commonly met with and the means available for the attainment of a satisfactory result in any given case. The book opens with a physiological dissertation which should enable the subsequent chapters to be read with intelligent interest. One feature that appealed to us in these first pages was the clarity of statement in respect of the Purkinje effect. We are attracted, too, by the preliminary arguments relative to the measurement of candle power, but the matter dealing with the definition of "candle" and "candle power" seem to be needlessly involved, and is in contrast with the definitions immediately following. The subject of brightness is but imperfectly understood by the majority, and Mr. Walsh's treatment of it is indeed welcome, while the information imparted regarding National Physical Laboratory photometry should be appreciated by all those who have at any time carried out photometric tests; some of the refinements may be thought unnecessary for commercial work, but they indicate the extreme accuracy aimed at, and show that reliance may be placed even on the final figures well known to those who handle National Physical Laboratory reports. Another feature which is of more than passing interest is that which fully deals with the effect of dimensions of the light source being tested. Too often is this question ignored, so that results are altogether invalidated; we have seen instances of this in laboratories of almost international repute.

There is little worthy of comment in the next chapter dealing with the distribution of candle-power, but we would call attention to the final paragraphs anent the integrating cube; it is, however, worth noting, and we think the author might have mentioned the point, that modern factories employ a specially adapted sphere for the testing and grading of every gasfilled lamp produced. We have yet to see an account of this instrument, which embodies novel mechanical and electrical features, and which cannot fail to be of interest to the general reader and the user of gasfilled lamps.

Modern light sources next claim our attention, and they are presented in an interesting manner. It is to be regretted that table III on page 60 cannot be compared in all particulars with tables I and II on the same page; the information would then have been of considerable service to electrical engineers. The importance of life tests of electric lamps is emphasised and exhaustively dealt with, the methods in use at Teddington being exampled, followed by information which should be of great service to all large users. The arc lamp, tungsten arc, vapour lamps, and other units are briefly but sufficiently described. The handling of the measurement and distribution of illumination is practically carried out, the precautions stated on pages 84-85 calling for especial note.

Indoor lighting next receives consideration, but little comment is required until one reaches the pages devoted to museums and art galleries, where we have the benefit of the author's research work on the matter. Shop-window lighting is very lightly treated; we should have thought the subject warranted much greater space than is allotted to it. Industrial and school lighting are covered by a special chapter, and the pith of governmental investigation may be said to be found in the pages devoted thereto. We are not impressed with the chapter on outdoor illumination, the tendency to particularise on a matter of but temporary importance being very apparent; the best portions of the chapter are those devoted to railway and vehicle lighting. Sign lighting is dismissed within thirty lines.

Daylight illumination next draws our attention, and here the author appears to be much more at home, and most useful information is to be gleaned respecting the subject. It is noteworthy that the majority of books dealing with light and

illumination ignore, or but briefly deal with, natural lighting; were the illuminating engineer to devote more study to the problems involved in natural lighting, the differences and losses at the time of and after changing over to artificial lighting would largely disappear. Colour in illumination is not overburdened with matter, and we have seen the subject much better treated; artificial daylight is but theoretically considered, and the practical side almost ignored. Light projection forms the basis of much interesting reading, the problem of motor-car headlights being included in this category.

The final chapter is devoted to bibliography; those wishing to elaborate upon any particular phase of the subject will find therein ample reference. In the appendix are stated the official definitions adopted by the International Commission on Illumination, and additional definitions and terms of British origin.

We are pleased with the work, considering it on the whole well balanced and the matter is well selected and ably presented; it may with confidence be included in one's library of technical works.

Wireless Telephony: A Simplified Explanation. By R. D. Bangay. Pp. viii+134; 79 figs. London: The Wireless Press, Ltd. Price 2s. 6d. net.

This book can be ranked "with but after" (as they say in the Army) the author's previous books on wireless subjects, and those were amongst the earliest, and are still amongst the best, of wireless books for the amateur worker. The great majority of people interested in the how and why of wireless signalling are what is called mechanically minded, and it is to them that Mr. Bangay particularly appeals, as he never fails to explain electrical phenomena by mechanical analogies. In fact for amateurs of this class, Mr. Bangay's books, including the one under review, are unequalled.

Such a reader can commence this book with a perfectly open, indeed blank, mind on all electrical phenomena, read it with pleasure, and close it with a sound knowledge of the fundamental principles of the transmission and reception of wireless telephony.

This is a good book, excellently produced, at a reasonable price.

Time and Weather by Wireless. By W. G. W. Mitchell, B.Sc., F.R.A.S., F.R.Met.S. Pp. xii+125; 66 illustrations. London: The Wireless Press, Ltd. Price 3s. 6d. net.

This book will be welcomed by many professional and amateur wireless workers, and by many others too who are interested in methods of transmitting time, and in forecasting weather, the popular British pastime.

Mr. Mitchell's articles on time and weather signals in the *Wireless World and Radio Review* were much appreciated, and are incorporated in this book, which is a regular mine of information on these subjects. No one even remotely interested in time signals or weather prophecies can afford to omit it from his reference bookshelf.

A good index, indispensable for such a book, is provided.

The get-up is excellent, the illustrations profuse and clear.

BUSINESS NOTES.

Bankruptcy Proceedings.—Edward Frederick Burrill, 173, Barnsbury Road, Isington, London, electrical engineer.—This debtor attended before Mr. Registrar Mellor at the London Bankruptcy Court on December 5th for public examination upon accounts showing liabilities £1,274 and assets "nil." In reply to Mr. Walter Boyle, Senior Official Receiver, the debtor said he was employed as an electrician for five years prior to December, 1918. In the following March he commenced business with two other persons as electrical engineers at 440a, Romford Road, E., under the style of "The Standard Electrical Maintenance Co."; each partner provided a capital of £300, and subsequently a fourth partner was taken into the firm and provided a further £500. In September, 1919, 'Semco, Ltd.,'' was formed, and took over the business for £4,000 in shares; witness received 1,000 £1 shares and acted as a director of the company until it went into liquidation in February, 1922. The debts of the business, which amounted approximately to £700, were taken over and discharged by the company. In September, 1922, witness and another person commenced business in partnership as electrical and wireless factors at Coptic Street, Bloomsbury, under the style of "Burrill, Wood & Co." Witness provided about £40, and remained a partner until March last, when, owing to differences with his partner, he retired from the business, which was then in a solvent condition. He attributed his failure to loss in relation to the Eclipse Hotel, Barnsbury, which he carried on from January, 1921, to May last; liability under a guarantee given by him jointly with another person on behalf of "Semco, Ltd.," for which he received no consideration; depreciation in the value of his shares in that company; and to his having lived in excess of his income. This was his first failure. The examination was concluded.

Selwyn Byers Weston, trading as the Westforrest Radio Co., Utworth Manor, Cranleigh, Surrey, late the Playhouse Arcade, High Street, Guildford, wireless apparatus manufacturer.—The following are creditors herein:—

	£		£
E. S. Ascott	247	G. Forrester	532
Biddles, Ltd.	34	A. Grove	13
Billimore & Son	42	Marconi Co., Ltd.	22
J. Birch & Co., Ltd.	49	F. Esbourn	46
Burndept, Ltd.	300	Siemens Bros. & Co., Ltd. ...	16
Carling, Gill & Carling	13	H. W. Sullivan, Ltd.	17
Dubilier Condenser Co., Ltd. ...	17	Thorpe	13
J. S. Edgley	14	Wainwright	15

W. M. Horsfall, electrical engineer, 7, Redcross Street, Liverpool.—First meeting December 14th, at the Official Receiver's office, 11, Dale Street, Liverpool. Public examination January 17th, at the Court House, Pilgrim Street, Birkenhead.

D. Johnson, electrical contractor, 177, Woodhorn Road, Ashington.—First meeting December 18th, at the Official Receiver's office, 4, Northumberland Street, Newcastle-on-Tyne. Public examination December 20th, at the County Court, Westgate Road, Newcastle-on-Tyne.

L. Backhouse, C. H. Thornton, and S. Evans (Arc Electrical Co.), electrical and wireless suppliers, Palatine Buildings, Victoria Street, Manchester. Trustee, Mr. A. T. Eaves, 15, Fountain Street, Manchester, appointed December 3rd.

S. Sidwell, electrical engineer, 51, Islington Row, Birmingham.—Receiving order made December 8th, on debtor's own petition.

G. W. Robinson, electrical engineer, 76, Cemetery Road, Porth, Glamorgan.—Receiving order made December 7th, on debtor's own petition.

H. Rogers, electrical engineer and contractor, Friars Gate and Barbauld Street, Warrington.—First meeting, December 19th; public examination, February 1st, both at the Court House, Warrington.

M. T. B. Gordon (T. Gordon), electrical and general merchant, late of 20, Western Broadway, King Street, Hammersmith.—Discharge granted, subject to consenting to judgment for £5 being entered against him (£5 paid to Official Receiver in lieu of entering up judgment).

Company Liquidations.—Clements, Jeakes & Co., Ltd.—Winding up voluntarily. Liquidator, Mr. A. Smart, 255, Finsbury Pavement House, E.C. Meeting of creditors December 20th, at the liquidator's offices. (The notice is merely formal; all creditors will be paid in full.)

Armature Repairing and Supply Co., Ltd. (in voluntary liquidation, and in the matter of the realisation of the debentures granted by the company and the trading account of the receiver from May 8th, 1923, to June 19th, 1923).—Particulars of claims by December 31st to Mr. A. O. John, Bank Buildings, Temple Street, Swansea, the receiver for the debenture holders, who is about to distribute to the debenture holders the amount collected in the course of his receivership.

Mitchell's Electrical & Wireless, Ltd.—First meeting of creditors and contributories, December 19th, at Carey Street, W.C.

Llandrindod Wells Electric Light & Power Co., Ltd.—Winding up voluntarily. Mr. J. Owens, secretary of the company, liquidator.

Home Radio & Electric Co., Ltd.—A meeting of members is called for January 14th, at 71, Kingsway, W.C., to hear an account of the winding-up from the liquidator, Mr. J. H. Read.

Private Arrangements.—W. E. Raybould, electrical engineer, Wilton Street, Derby.—The creditors interested herein were called together recently, at Derby, when a statement of affairs was presented, which showed liabilities of £541, made up as follows:—Trade creditors, £372; cash creditors, £160; and liability on shares, £8 15s. The assets only consisted of: Trade debtors, £20; and stock, £5. There was a preferential claim for rent amounting to £32, and it was pointed out that the assets were insufficient to discharge that claim in full. It was stated that the debtor had previously made an offer of a composition of 5s. in the £, but it fell through, as certain creditors refused to accept it. He commenced trading in 1919 as an electrical engineer with little or no capital. On behalf of the debtor an offer was made of a composition of 2s. 6d. in the £, payable in cash, which it was decided should be accepted.

Dissolutions of Partnership.—Terrett & Sheppard, electrical engineers, 10, Stanley Parade, Wembley, and 15, College Parade, Kilburn.—Mr. W. G. Terrett and Mr. S. C. Sheppard have dissolved partnership. Mr. Terrett, of 10, Stanley Parade, Wembley, will attend to debts.

Newman & Corbishley, plumbers and electricians, 34, Chestergate, Macclesfield.—Mr. W. P. Newman and Mr. C. H. Corbishley have dissolved partnership. Debts will be attended to by Mr. Newman, who will continue the business.

Ray Engineering Co., electrical engineers, Frogmore Street, Bristol.—Mr. R. St. C. Carter and Mr. E. H. Dixon have dissolved partnership. Mr. Carter will attend to debts and continue the business.

Deed of Assignment.—J. L. Cartwright and H. C. Gee (J. L. Cartwright & Co. and Victor Best & Co.), electrical manufacturers and suppliers, Victoria Works, Springfield Lane, Salford, and 22a and 24, London Road, Manchester.—Particulars of claims by December 24th to the trustee, Mr. A. Hodcroft, 7, Brazennose Street, Manchester.

Trade Announcements.—Premises at 133, High Street, Slough, have been opened by Mr. A. E. Peplow, electrical engineer and wireless expert.

Mr. Robert Ormiston, electrical engineer, has opened new premises in Meadow Place, Bank Street, Alloa.

Owing to the renumbering of Park Lane, Leeds, the address of the branch of the Siemens & English Electric Lamp Co., Ltd., in that thoroughfare has been altered from 85-91 to 129.

Messrs. L. McMichael, Ltd., of London, have opened a branch business at 5, Yelverton Road, Bournemouth.

Weldrics (1922), Ltd., of Bush Lane House, Cannon Street, London, E.C.4, has purchased the business of Messrs. T. Scott Anderson, electrical welding engineers and equipment manufacturers, of Royal Insurance Buildings, Church Street, Sheffield, and is continuing the offices as a branch establishment.

Mr. H. E. Haynes has resigned his appointment as a director and manager to Messrs. J. W. Barnard & Haynes, Ltd., with whom he has been connected for over 25 years, and has commenced business on his own account, at 46, Garden Row, London, S.E.1, where he will carry on a special battery service-supply, repairs, replacements, &c. Telephone: "Hop. 2035."

Catalogues and Lists.—John Thompson Water Tube Boilers, Ltd., Wolverhampton.—List of stock of patent straight-tube vertical-type boilers, with a sectional illustration.

The Aster Engineering Co. (1913), Ltd., Wembley, Middlesex.—List No. F. 83, illustrating and describing the "Aster British Light" semi-automatic generating plant for country-house lighting; Lists Nos. F. 98 and 98a, giving particulars of small belt-driven sets; and Lists Nos. 100 and 100a, containing specifications and prices of lighting sets.

The Sun Electrical Co., Ltd., 118 and 120, Charing Cross Road, W.C.2.—Two priced and illustrated booklets, containing particulars of "Sunlite" reflectors for numerous purposes, and "Brascolite" fittings of a variety of designs.

Messrs. H. C. Slingsby, 89, 95, and 97, Kingsway, W.C.2.—A pamphlet illustrating and describing the "Jacklift" lifting truck and other goods-handling apparatus.

Mr. J. R. Morris, Imperial House, 15-19, Kingsway, W.C.2.—An illustrated leaflet advertising the "Columbia" steel-cased "Hot Shot" battery.

The Carpax Co., Ltd., 312, Deansgate, Manchester.—A folder advertising the "Gold Seal Homcharger" for charging accumulators from electric lighting installations.

Mr. Hugh M. Todd, 124, Govan Road, Mavisbank, Glasgow.—A blotter bearing a humorous illustration and advertising an electric power and lighting, &c., business.

Mr. J. C. White, 49, Bridge Street, Deansgate, Manchester.—A postcard illustrating corrosion-proof wiring fittings for use with c.t.s. cable, &c.

Messrs. Ward & Goldstone, Ltd., Frederick Road, Pendleton, Manchester.—An illustrated and priced sheet containing particulars of dry batteries for use with dull-emitter radio valves.

Brookhirst Switchgear, Ltd., Northgate Works, Chester.—Three folders containing illustrations and information relating to the firm's oil-immersed a.c. control gear.

Marconi's Wireless Telegraph Co., Ltd., Marconi House, Strand, W.C.2.—A series of illustrated and priced booklets describing in some detail "Marconiphone" radio receiving sets, loud-speaking equipment, &c.

Spencers (Electrical), Ltd., 7, 8, and 9, White Cross Place, Wilson Street, E.C.2.—A price list of "Conqueror" lamps of various types, including carbon and automobile lamps.

Messrs. Crossley Bros., Ltd., Openshaw, Manchester.—An illustrated brochure advertising the firm's productions—oil and gas engines, pumping plant, automobiles, light locomotives, &c.

Calendars.—Messrs. Bruce Peebles & Co., Ltd., have sent us the 1924 cards for the handsome metal calendar stand with a date-cancelling device sent us a year ago.

From Messrs. Crossley Bros., Ltd., we have received a wall calendar with monthly sheets bearing illustrations of the firm's gas and oil engines, &c.

Projected Developments in Uruguay.—According to *Reuter*, a considerable number of new public works will be undertaken as soon as financial arrangements, now in hand, have been completed. The projects call, *inter alia*, for an extension of the State telegraphic system; an installation of water and drainage systems for the towns of San Remón and San Carlós; further extensions at the port of Montevideo, with improvements at the Atlantic port of La Paloma; the installation of eight new overhead transporters at the State electric light works; the reconstruction of the Customs house; and the electrification of the State tramway system at Montevideo.

For Sale.—Halifax Tramways and Electricity Committee has for disposal one 750-kW. d.c. generating set. Tunbridge Wells Corporation Electricity Department invites offers for two Lancashire boilers, several turbo-alternator sets, Lea recorders, indicators, &c. By order of George Cohen & Armstrong Disposal Corporation, Messrs. G. N. Dixon & Co. will sell by auction at the C. S. Depôt, Queen's Drive, Walton, Liverpool, on January 3rd, and at the C. S. Depôt, Aintree, on January 4th, plant, machinery, generating sets, electrical machinery, &c. Rhyl U.D.C. Electricity Department has for disposal surplus steam generating sets, &c. By order of the liquidator of Jas. Scott, Ltd., electrical engineers, Knowsley Road, Bootle, Messrs. G. N. Dixon & Co. will sell by auction on December 19th and following days, on the premises, Knowsley Road, the whole of the plant, machinery, tools, stock, office fittings, &c. (See our advertisement pages to-day.)

Industrial Patents.—In *The Times Trade and Engineering Supplement*, a correspondent discusses the resolutions which were adopted by an important conference on patents held in London recently, and attended by delegates from 16 leading trade and industrial associations and chambers of commerce. This conference has done much to focus the views of British business organisations interested in this subject. In the past the Patent Conventions have been drafted without much consideration of the views of manufacturers, and the work which is now being done in preparation for The Hague Conference, which may be held in 1924, or more probably in 1925, will ensure that the views of manufacturers in this country are properly considered. It is proposed to form a permanent central organisation in this country, exclusively devoted to industrial property matters and working in close co-operation with the various technical and trade associations, in order to facilitate the expression of the united views of British traders on industrial property matters, and to exert the full weight of British influence at the various international gatherings at which trade mark and patent questions are considered.

German Works in Bohemia.—It is stated that the A.E.G., of Berlin, has decided to erect manufacturing works in Prague, Bohemia, for the production of all kinds of electrical goods. The company has for a number of years past held interests in Czecho-Slovakia, but owing to the high import duties and the restrictions on imports it intends to start manufacturing there on its own account.

Electrical Industry: Increased Activity.—In the *Bulletin* of the Federation of British Industries, a correspondent, in the course of a report on certain trades, refers to the electrical industry as follows:—"Reports from various sources indicate a distinct increase in demand owing to the erection of new power stations both at home and in the Dominions. Much of the work secured in the home market is due to the enterprise of various municipalities, but another development is also of interest, namely, the demand for self-contained lighting units for private houses which are not in touch with large sources of supply. In the main this type of order comes from overseas. Indeed, one or two firms have had so many orders for these sets that they have had to put on night shifts again."

The Cost of Lighting.—Condor Lamps (Great Britain), Ltd., has published a table showing how many hours' illumination can be obtained for a penny with lamps of different sizes and varying prices for energy. This should prove of interest to consumers.

British Empire Exhibition Notes.—All parts of the British Empire will be connected by telephone at the British Empire Exhibition at Wembley next year. A system of internal communication is being installed by the Relay Automatic Telephone Co., Ltd., to connect all the Dominion and Colonial sections with each other and with the exhibition headquarters—over two hundred lines. The switchboard, which will be accommodated on Stand S. 778 in the Building Section, will be open to the inspection of visitors and should prove of considerable interest, as comparatively few people have seen an automatic exchange in operation.

The Relay Automatic Co. is at present working on the switchboard. Work in installing the lines was begun on December 1st, and the whole system will be ready for use on January 1st. In addition to the exchange in the Building Section, the Relay Co. is occupying a site of 500 sq ft. in the Engineering Section, where models of public and private automatic exchanges and private automatic branch exchanges will be shown in operation. A private automatic branch exchange is also being exhibited in the British Government Pavilion.

Hours of opening and closing the British Empire Exhibition have now been fixed. The exhibition grounds will be open from 10 a.m. to 11 p.m., except Sundays. Exhibits will be on view from 10 a.m. to 10 p.m. No exhibitor will be required to keep any machinery moving or full staff in attendance at stalls after 8.30 p.m. from Mondays to Fridays inclusive, or after 9.30 p.m. on Saturdays, but otherwise exhibitors will be expected to keep their exhibits fully on show between 10 a.m. and 10 p.m. With regard to sales, exhibitors will be permitted to arrange their own hours between 10 a.m. and 10 p.m. subject to the provisions of the Shop Hours Act.

Overseas Advertising.—The Dorland Agency, Ltd., 16, Regent Street, London, S.W.1, and at New York, Paris, Buenos Aires, and Rio de Janeiro has been appointed by the British Empire Exhibition as sole agent for all oversea advertising.

Our Commercial Counsellor in Japan.—The Board of Trade *Journal* announces that in consequence of the destruction by earthquake of the Office of the Commercial Counsellor at Yokohama, arrangements have been made for the work of that officer to be carried on at Tokio. H.M. Ambassador has reported that the Commercial Counsellor's Office is now established at the British Embassy. All commercial inquiries intended for him should be addressed to:—The Commercial Counsellor, British Embassy, Tokio.

Rhodesian Mining Power Plant.—The Rhodesia Broken Hill Development Co. announces that excellent progress is being made with the construction of the Mulungushi power plant. One-fifth of the dam wall is already in place, and the tunnel, by-pass, &c., have been completed to ensure safe and continuous construction work during the present rainy season, so that the dam shall be filled with water during the rainy season of 1924-25. Orders have been placed for a portion of the power plant and transmission line. The completed plant will provide 10,000 h.p. Of this it is confidently expected that 2,500 h.p. will be available at the mine by the end of 1924. About 34 Europeans and 1,600 natives are employed on the work.—*Financial Times.*

Patent Applications.—Application has been made for the restoration of the following patents: Patent No. 21,437 of 1914, granted to Beindorff & Co.'s fabriek van Ketelbekleeding en Isolatiestof "Isola," for "Improvements in or relating to the manufacture of heat insulating compounds. Patent No. 4,862 of 1913, granted to Thos. Edward Gambrell for "Improvements in electric contact makers for use with resistance boxes, Wheatstone bridges, and the like."

E.D.A. Activities.—We have received two more pamphlets from the British Electrical Development Association. The first depicts a man shaving while being kept warm by a bowl fire. The legend reads: "Twenty minutes' comfort for one farthing." The other shows a family group: "Daddy tells a Christmas ghost story." Above an electric fire, around which the family is assembled, appears the shadowy form of a coalman bearing a full sack—a very unromantic ghost.

Electric Clocks.—The Synchronome Co.'s system of electric clocks is being installed in Britannic House, the new head offices of the Anglo-Persian Co., Ltd.

British Trade-mark Applications.—The following are among the recent applications for British trade marks. Objections to any of the proposed marks may be entered within one month from the dates mentioned. In the case of foreign applications the names and addresses of the British representatives are also given.

Clinosol (lettering and design). No. 438,641. Class 11. Electrical apparatus for therapeutical purposes. Luigo Martignoni, 31, Via XX Settembre, Genoa, Italy. (Herbert Haddan & Co., 31-32, Bedford Street, Strand, London, W.C., November 29th, 1923.

Gebruder Siemens & Co., Berlin (lettering and design). No. 421,148. Class 4. Arc electrodes of carbon. No. 421,149. Class 8. Searchlight apparatus. No. 428,652. All goods in Class 13. Carl Friedrich von Siemens, trading as Gebruder Siemens & Co., 128-137, Herzbergstrasse, Lichtenberg, Berlin, Germany (Marks & Clerk, 57-58, Lincoln's Inn Fields, London, W.C.). December 5th, 1923.

Celsio. No. 441,729. Class 6. Electric vacuum cleaning machines. Harold E. Chamberlain, 19, Buckingham Street, Strand, W.C. December 5th, 1923.

Ducon. No. 437,083. Class 8. Condensers and adaptors for use in place of aerials for wireless telegraphic and telephonic apparatus. The Dubilier Condenser Co. (1921), Ltd., Ducon Works, Goldhawk Road, Shepherd's Bush, London, W. December 5th, 1923.

Design of Elephant. No. 438,065. Class 13. Electric junction boxes for the Indian market only. Callender's Cable and Construction Co., Ltd., Hamilton House, Victoria Embankment, London, E.C. December 5th, 1923.

Texso. No. 441,635. Class 13. Electrical, gas, and water fittings. Arthur Mundell, 20, Bucklersbury, London, E.C. December 5th, 1923.

Biflector. No. 442,043. All goods in Class 13. Benjamin Electric, Ltd., Brantwood Works, Tariff Road, Tottenham, N. December 5th, 1923.

Claristral. No. 441,510. Class 8. Wireless telephonic receiving sets.

Ward & Goldstone, Ltd., Frederick Road, Pendleton, Manchester. December 5th, 1923.

Radiotron. No. 441,529. Class 8. Telegraphic and telephonic instruments. The British Thomson-Houston Co., Ltd., Crown House, Aldwych, London, W.C. December 5th, 1923.

Sonyte. No. 441,705. Class 8. Detector crystals for wireless telephonic receiving sets. Ward & Goldstone, Frederick Road, Pendleton, Manchester. December 5th, 1923.

The Smithfield Show.—Among the exhibitors at the Smithfield Show, which closes to-day, are Messrs. Ruston and Hornsby, Ltd., and Petters, Ltd. The former firm displays petrol-paraffin engines ranging from 2½ to 7½ h.p., one of them, a 5 h.p. engine, being coupled to a 2½-kW generator. Other exhibts are a crude-oil, cold-starting engine, a refined-oil engine, pumping plant, traction engines, &c. Messrs. Petters, Ltd., show several small oil engines and pumping and lighting plant, including the "Petter-Light" generating set for small factory or house lighting.

Dry Cells for China.—Various brands of locally-made dry cells, as well as accumulators, have recently appeared on the Chinese market. The China Storage Battery Manufacturing Co., of Shanghai, is reported to have a monthly production of 3,000 dry cells and 5,000 wet batteries. The Great Eastern Electric Battery Factory, also of Shanghai, is making dry cells for call bells and pocket lamps, its plant having, it is stated, a capacity of 10,000 per month.

Leipzig Impressions.—A member of a British firm of electrical manufacturers which held a stand at this year's Leipzig Fair, and was probably the first British firm to do so since pre-war days, has given us his impressions of the Fair under the present uncertain conditions. He mentions several examples (tragic or humorous, according to the angle of view) of the absurdity of the mark currency. The point which interested us most in his communication was the fact that he was able to *sell* electrical apparatus to Germans—certainly in a small way—and that many inquiries were received from German, Dutch, and Scandinavian firms. Our correspondent also says that his firm's prices appeared to be much lower than those of German competitors. The Fair is evidently undergoing a transformation into something of a more permanent nature, as we are told that new buildings and roads are being rapidly constructed. As regards visitors, our correspondent says that very few Americans and only six British visited his stand, while he did not see any French or Japanese.

Unemployment.—The Ministry of Labour returns for the week ended December 3rd showed that the total number of unemployed was 1,194,700, a decrease of 23,524 in the week, and of 291,178 since the beginning of the year.

Staff Dinner.—On December 6th, at the Restaurant Frascati, W., the senior members of the male staff of the Hart Accumulator Co., Ltd., met at dinner under the chairmanship of Mr. F. J. Holmes, M.I.E.E., manager and director. The gathering included men from the company's Scottish, Manchester, Birmingham, and York branches. After an excellent dinner a short toast list was interpolated between concert items. Mr. Rouard proposed the toast of the company and Mr. Holmes, replying, said that the name "Hart" was becoming a household word wherever batteries were used. He also asked the permission of those present to convey best wishes to the staff of the daughter company at St. John's, Quebec, which was unanimously accorded. Mr. J. Breeze proposed the health of the guests and Mr. S. Rentell replied on their behalf. The thanks of the gathering were accorded Mr. Dunkerton, who carried out the arrangements in an admirable manner.

Ozonair Contracts.—Ozonair, Ltd., has just completed, or has in hand, installations of its system of pure-air ventilation in the following important places:—

Liberty & Co., Ltd.—New premises, Tudor House, Argyll Place, W.
Style & Mantle, Ltd.—Premises, Oxford Street, W.
C. & A. Modes, Ltd.—Premises, Oxford Street, W.
City of London Corporation.—Underground convenience.
Chelsea Borough Council.—Underground convenience.
T. Wainwright & Sons, architects, Liverpool.—Public fruit sale room.
Société Générale de Belgique, Brussels.—Bank premises.
Bon Marché, Brussels.—New premises.

Venezuela's Foreign Trade.—A *Commercial Reports* review of the foreign trade of Venezuela during 1922 shows that of a total value of 2,099,402 bolivars, representing the import of electrical apparatus and accessories, the United States supplied the equivalent of 1,380,235 bolivars. The imports of electric lamps totalled in value 481,212 bolivars, to which the United States contributed 180,511 bolivars and the United Kingdom 48,491 bolivars. The two countries supplied the bulk of the machinery (agricultural and non-agricultural) imported into Venezuela. In the aggregate (including spares) the United States supplied machinery to the value of 5,649,009 bolivars, while the value of the United Kingdom's contribution was 2,606,339 bolivars.

The British Industries Fair.—The *Board of Trade Journal* records a satisfactory demand for space in both the London and Birmingham sections of the 1924 British Industries Fair, and prospective exhibitors are urged to make immediate application if they have not already done so. The increased demand is no doubt due to the remarkable reductions which have been made in the charges. For instance, a stand having an area of 200 sq. ft. cost £26 13s. 4d. in 1921; the charge for next year's Fair is £13 13s. It is considered that the change of date to the end of April and the beginning of May will be conducive to a much larger attendance, and the avoidance of overlapping of the two sections will also have a good effect.

New Belgian Company.—There has been formed at Liége a company styled the Compagnie d'Electricité des Ardennes for the production of electricity for lighting and power, and the acquisition of concessions to supply to towns and townships. Its capital is fixed at 1,500,000 fr. in 500-fr. shares. There are besides 1,500 founders' shares of no nominal value, of which 1,060 and 800 fully paid-up shares are allotted as consideration for assets.

Electrical Business in South Africa.—According to the *S.A. Mining and Engineering Journal* for November 17th, the general opinion among electrical goods merchants is that things are moving slightly—nothing big, but a slow uplift from the lethargy of past months.

Book Notices.—"Plan Copying in Black Lines for Hot Countries," by B. J. Hall. (Pp. vi+15). London: Sir Isaac Pitman & Sons, Ltd. Price 2s. 6d. net.—As ferro-gallic paper deteriorates rapidly in a humid atmosphere, a process which was formerly used by photo printers in England is revived. The author is a principal in a well-known firm of experts in this subject, and it may be taken for granted that by means of his instructions prints as satisfactory as those included in the book as samples can be produced. The price of the volume will appear high to many: the subject has been expensively treated.

"The Development of Water Power" (pp. 58, ill.). Ringwood, Hants: Messrs. Joseph J. Armfield & Co., Ltd. Price 2s. 6d. net.—While this publication is to a great extent a catalogue of Messrs. Armfield's water-power plant, it is at the same time a practical manual upon water-turbine installation, water measurement, &c. This part is well illustrated by means of clear diagrams. The catalogue portion deals very fully with the characteristics and capabilities of various types of turbines made by the firm—as well as ordinary water wheels, governors, valves, and other hydraulic plant, and the section is copiously illustrated.

"The *Transactions* of the South African Institute of Electrical Engineers." October, 1923. Johannesburg: The Institute. Price 2s.—The principal paper reproduced in this issue of the journal is entitled "The Electrical Kitchen for Private Houses," by Prof. H. Bohle, M.I.E.E. The author describes the general construction of such appliances as ovens, hot-plates, grills, and kettles, and discusses their efficiency. A section is devoted to water heating, and costs are dealt with. The author also puts forward a number of suggested regulations to govern the manufacture of cooking vessels.

"The *Journal* of the Junior Institution of Engineers." December, 1923. London: Percival Marshall & Co. Price 2s. —In this issue appear two papers: "Recent Progress in Engineering," by Prof. J. Husband; and "Musing without Method," by Mr. H. J. Brackenbury, as well as a lecture by Mr. W. Yorath Lewis on "The Never-Stop Railway." Other matters include reports of "lecturettes," proceedings of local sections, visits, &c.

A new weekly journal—*Revue Universelle des Transports*—dealing with all matters connected with the transport of passengers and goods by land, sea, or air, will commence publication in January at 4, Rue du Rocher, Paris (VIIIe).

"Modern Radio Communication," by J. H. Reyner. Pp. xi+208; 121 figs. London: Sir Isaac Pitman & Sons. Price 5s. net.

"Railway Amalgamation in Great Britain," by W. E. Simnett. Pp. 276; 4 maps. London: *The Railway Gazette*. Price 15s. net.

"Elementary Steam Power Engineering," by E. MacNaughton. Pp. viii+590; figs. 468. London: Chapman and Hall, Ltd. Price 25s. net.

New Italian Companies.—There has been launched at Solofra (Avellino) the Società Anonima Luce Elettrica Solofra, with a capital of 150,000 lire, for the development of the hydro-electric and kindred industries.

The Società Industrie Pesaresi Elettriche is a new company formed at Pesaro to take over another company of the same name. Its capital is 720,000 lire, divided into 1,440 500-lire shares.

There has been embodied at Rome the Italo Radio-Società Italiana per Servizi Radioelettrica, for the development of the use of wireless in Italy. Its capital is the large sum of 7,000,000 lire in 14,000 shares of 500 lire each.

For the purchase and working of patents relating to the electric furnace, the Società Forni Elettrici has been established at Rome with a capital of 250,000 lire in 250 1,000-lire shares.

For the supply of electricity to the town of Vazio and its neighbourhood there has been formed at Vazio (Tremosine province) the Società Elettrica di Tremosine, with a capital of 77,000 lire, raisable to 300,000 lire, divided into 154 shares of 500 lire each.

The Association of British Exhibitors.—With the formation of the Association of British Exhibitors (detailed in our "New Companies" list of November 30th) almost complete, stallholders may look forward to some fundamental changes taking place in the organisation of exhibitions. The Association (with headquarters at 69, Victoria Street, Westminster, S.W.1) is composed of manufacturers and firms who have become incorporated for the purpose of safeguarding and advancing the interests of stallholders at exhibitions and trade fairs.

The first purpose of the Association is to bring about better working conditions between exhibitors and exhibition promoters. At the present time these conditions leave much to be desired. Agreements between the two parties concerned are not always completed upon an equitable basis, and in these one-sided agreements questions relating to space rents and the fitting of stands and stalls figure very largely.

Of equal importance are matters which are concerned more with the actual equipment of exhibitions, such as motor hire, lighting installation, and light consumption. These, although generally quite adequate, are often charged for at a rate out of all proportion to the usual charges for such services. Again, one of the most prevalent sources of dissatisfaction among exhibitors throughout the country is the frequent lack of catering and other facilities which exists at many exhibitions. The lack of these facilities means that exhibitors have to "rough it," and there is a widespread feeling that these conditions, unfavourable as they are to the working of the exhibition, could be obviated if a little trouble and foresight were brought into play by the exhibition promoters. Another matter of paramount importance, and one which is often neglected among those organising exhibitions, is the question of publicity; unless an exhibition receives its proper quota of advertisement, a large attendance cannot be hoped for. It would be expected that the exhibition organisers would be the first to appreciate the force of a sound publicity campaign, since the lack of provision in this matter is always bound to have an adverse influence upon the entrance returns, yet it is observed that the question of influencing the public is often relegated to a position of inferiority by those who would benefit the most by it.

In all the questions enumerated, and incidentally in many others, the Association of British Exhibitors will give the best assistance to the stallholders. Where matters are unsatisfactory it will be the duty of the Association to investigate and bring about the appropriate alteration. Already the Association, in spite of the fact that it yet has to do a considerable amount of spade work in building up its organisation, has undertaken the task of making representation to the railway companies to allow to all exhibitors at exhibitions and trade fairs the concession to return all unsold goods and exhibition plant at half rates. Previously this concession was allowed only to exhibitors at agricultural shows; but the first essential to success in this and in all other work which the Association undertakes, depends first and foremost upon the numerical support of all exhibitors throughout the country.

Jugo-Slavian Bauxite.—The increased working of the deposits of bauxite in Jugo-Slavia in recent years is said to have become of importance, particularly for the German aluminium industry, which received most of the production of the former country in 1921. Bauxite from France is not available to the German works, while the German deposits in the Vogelsberg and in the Westerau are insufficient for the industry. The Government at Belgrade is now making it a condition that the German deliveries on reparation account must be carried out if the aluminium industry is to be permited to import further quantities of bauxite from Jugo-Slavia.

Imperial Cable System.—West Indian Extension.—At the recent Imperial Conference it was stated that the All-British chain of submarine telegraph cables was to receive an important and much-desired addition in the shape of a new cable from Turks Island to Barbados, whence it would be taken to Trinidad on the one hand and to British Guiana on the other. The total length of new cable amounts to 1,700 nautical miles. The order has been placed with Messrs. Siemens Bros. & Co., Ltd., Woolwich, who have contracted to manufacture and lay the cable next summer. The cable will embody all the latest improvements.

Foreign Capital for Italy.—Senator Prof. Achille Loria, president of the Istituto Internazionale per Finanziamenti Esteri (Foreign Financing International Institute), informs us that the object of his association is the financing of national works by means of foreign capital. The programme includes railway electrification, the erection of hydro-electric power stations, electro-culture, &c. The address of the Institute is Via Condotti, 91, Rome.

Swedish Engineering Industry.—*Swedish Export*, the journal published by the General Export Association of Sweden, states that in spite of difficulty in obtaining raw material, the Swedish engineering industry brightened up considerably during the past quarter, there being few unemployed, following upon improvements in the two preceding quarters. The industry, however, is still working under unpropitious conditions, partly owing to unfavourable prices and partly because the production in hand does not correspond to normal work, and is therefore insufficient for otherwise normal expenses.

Swiss Electrical Industry.—The sound condition of the Swiss electrical industry is shown, according to a Swiss bank's estimate, by the fact that there are among new stations being built or about to be begun, the Oberhasliwerke of 213,000-h.p. capacity and 627,000,000 kWh yearly output; the Wäggital power station (140,000-h.p. capacity and 110,000,000 kWh output in winter); the Vernayaz station (85,000 h.p. and 170,000,000 kWh); as well as three other stations with a total of 86,000 h.p. and 165,000,000 kWh. Furthermore, there are four bigger stations undergoing enlargement, including the Amsteg station and the Olten-Gösgen, to a total addition of 47,000 h.p. On the other hand, there are several undertakings, such as the Nord-ôst Schweizeriache Kraftwerke and the "Mobor" Co., the completion of whose stations is delayed by the present high cost of construction and the prospective inadequate current demand. The economic crisis at present prevailing in Switzerland is exerting a retarding effect on the consumption of current generally, but most of the big undertakings, especially the big power groups, show an increase in the call for current. The larger concerns

have likewise hitherto been able to pay regularly from 5 to 8 per cent. dividends. A feature in the situation is that the export of energy, owing to difficulties of contract formalities and currency shrinkages, is not found to be very profitable. Linking-up of stations with a view to economic working of stations is being increasingly resorted to, as well as the building of winter stations to facilitate power production. It has also become recognised that the provision of electric power is an economic necessity; and this explains the efforts of the Federal railways and many big private undertakings, such as electro-chemical and metallurgical concerns, to set up and work their own power establishments.

Switzerland seeks to reserve its orders for manufactured goods to home firms as far as possible, and this is particularly the case in the electrical installation department. Occasions arise, however, when, for various causes, some orders are placed abroad. To cater for such calls it is useful to observe that the wire and cable most generally used in Switzerland are those insulated according to the requirements of the Swiss Electricians' Association, which fulfils the office of a control board. Although under no obligation so to do, the greater number of Swiss cable manufacturers insert what is termed a *fil pilote* (literally pilot wire), which distinguishes the home article from that made abroad. Conditions of tender, or *cahier de charges*, are not accessories to business operations, as in France. In Switzerland the sale of electric wire and cable is done in two ways: Either manufacturers stock their goods with wholesale firms to sell, and customers draw their supplies from these; or they employ an agent or traveller who places their goods with either a trading firm or contractors or local authorities direct. The terms of business in general in Switzerland usually imply a discount of 10 to 15 per cent., with payment by draft at sight or in 90 days.

Forthcoming Exhibitions.—The following exhibitions are being organised for 1924:—

London.—Ideal Home Exhibition, February 28th to March 22nd; British Empire Exhibition, April to October; British Industries Fair, April 28th to May 9th; Machine Tool and Engineering Exhibition, September 5th to 27th.

Birmingham.—British Industries Fair, May 12th to 23rd.

Norwich.—Ideal Homes and General Trades Exhibition, January 31st to February 9th.

Warrington.—Industrial Trades Exhibition, February 6th to 16th.

Wolverhampton.—Ideal Homes and General Trades Exhibition, February 13th to 28th.

Australia (*Melbourne*).—Electrical Exhibition, September.

Belgium (*Brussels*).—Agricultural Machinery Exhibition, February 16th to 25th; International Commercial Fair, April 1st to 16th.

Cuba (*Havana*).—International Sample Fair, February 9th to 24th.

Czecho-Slovakia (*Prague*).—International Sample Fair, March 16th to 23rd.

France (*Paris*).—Agricultural Machinery Exhibition, January; (*Nantes*).—Exposition Nationale, May to October. (*Rennes*). Fair and Exhibition, April 26th to May 4th.

Holland (*Utrecht*).—Fair, March 11th to 20th.

Italy (*Milan*).—International Sample Fair, April 12th to 27th.

Spain (*Barcelona*).—Sample Fair, March.

A Sun Dance.—A very successful dance, arranged by members of the staff of the Sun Electrical Co., Ltd., was held on Saturday last, December 8th.

Trade with Argentina.—In the November review of affairs issued by the London and River Plate Bank, reference is made to the import trade with Great Britain. It is stated that at Buenos Aires United States trade is becoming more and more confined to the specialities associated with that country. Agricultural plant and motor-cars probably take pride of place, and in connection with the latter line it may be of interest to mention that Ford sales in Argentina for the current year are expected to reach 20,000, which will be a world record. They are assembled there, and the recently built factory where this is done is to be extended, and given a capacity for turning out 200 cars daily, at need. In hardware, steel and iron the Belgian and French effort to monopolise the market continues, Belgium having virtually secured all orders for steel rails given by both the State railways and the Province of Buenos Aires, while French firms stocking building steel are reported to have booked several important constructional contracts. French machinery manufacturers, represented by the Longovica interests, are also offering cheap pumping and electrical plant, while various small tenders for round and hoop iron have also gone to French firms. In high speed steel the British product is, however, said to be so infinitely superior that neither French nor German offers have any chance of consideration where quality is in question, notwithstanding that German steel is scarcely half the price of the Sheffield quotation. Building in Buenos Aires, and in several provincial centres has shown marked increase of late, and this creates a demand for fittings, &c,

LIGHTING AND POWER NOTES.

Barnoldswick (Yorks.).—Electricity Supply.—The Urban District Council has submitted to the Electricity Commissioners an objection to the town's inclusion in the proposed Aire and Calder electricity scheme, and states that an electricity supply should be obtained from Lancashire. Negotiations are already proceeding with a view to obtaining a bulk supply from Nelson. It is objected that the capital expenditure involved in transmission lines from the West Riding sources would prevent the Urban Council from supplying electrical energy at a reasonable price.

Bicester.—Electricity Supply.—At a recent meeting of the Urban District Council, a letter was read from Mr. J. R. Reef, of Market Square, Bicester, stating that it was his intention to form a company with a capital of £10,000 for the purpose of establishing an electricity works in the town. He stated that he was prepared to enter into an agreement for the Council to purchase the undertaking after a certain period, to allow the Council a special flat rate for street lighting, &c., and to guarantee that the price to consumers would be at least 50 per cent. below the prevailing price of gas in the town. The Council is to hold a special meeting, at which Mr. Reef will attend, to go into the matter.

Birkenhead.—Special Order.—The Corporation has applied to the Electricity Commissioners for a Special Order giving it powers to extend its area of electricity supply so as to include the Urban District of Bebington and Bromborough.

Blackburn.—Mains Extensions.—The Town Council has approved an estimate amounting to £32,000 for additional cables, material, &c., in connection with the laying of a second set of trunk feeders between Whitebirk generating and Jubilee Street distributing stations. Application is to be made for a grant from the Unemployment Grants Committee.

Blackpool.—Extension of Supply.—Subject to approval being obtained from the Electricity Commissioners, the Corporation proposes to give a supply of electricity to Thornton.

Bideford.—Special Order.—The Bideford and District Electric Supply Co., Ltd., has applied to the Electricity Commissioners for a Special Order authorising it to supply electricity within the boroughs of Bideford and Great Torrington, the Urban District of Northern and certain parishes in the Rural Districts of Bideford, Barnstaple and Torrington.

Bradford.—Loan Sanctioned.—The Electricity Committee have received the sanction of the Electricity Commissioners to the borrowing of £12,500 for electricity purposes.

Bridlington.—New Plant.—The Town Council is to install new boiler plant at the electricity works, and carry out extensions to the condenser plant at an estimate cost of £6,500.

Canterbury.—Loan.—The Town Council has applied to the Electricity Commissioners for sanction to a loan of £5,000 for two new feeder cables.

Clitheroe.—Special Order.—Application has been made to the Electricity Commissioners by the Lancashire Electric Power Co. for a Special Order authorising it to supply electricity in the town.

Continental.—France.—The first stage of the works for the electrification of the Department of the Côtes du Nord consists of the harnessing of the Upper Blavet river and the building of a hydro-electric station at Guerléden. The scheme was drafted by the Société Générale d'Entreprises, which will also set up the distribution network required, both in the Côtes du Nord and in Morbihan. The scheme involves the building of a dam at Mur-de-Bretagne 46.50 metres high, with a capacity of 70,000,000 cubic metres. The water will be conveyed to three turbines, each driving a 3-phase, 3,000-kW alternator. It is intended to link up the Guerlédan station with the station at Aber Wrac'h, to supplement the output of that station during unfavourable periods of the tides.

A meeting has been held at Baugy (Cher Department) of communes interested in rural electrification. Delegates of over 70 communes were present. It was stated that financial assistance would be obtained from the Ministry of Agriculture and the departmental authorities.

Douglas (I. of M.).—Opposition to Extensions.—The proposed extensions to the electricity works are being held up owing to the opposition of property owners in the locality, who state that the vibration caused is damaging their property. The Corporation has applied to the Government for sanction to the borrowing of £45,000 for plant extensions, but the Government has decided to withhold consent pending a settlement of actions for damages entered against the Corporation.

Eccles.—Year's Working.—The 1922-23 accounts of the municipal electricity undertaking (engineer: Mr. H. W. Angus) show that the total revenue was £38,711. The working expenditure amounted to £28,742, and the gross profit was thus £10,239. In the previous year the equivalent figures were: Income, £38,177; working expenses, £29,642; and gross profit, £8,535. The capital charges were somewhat lower than those of the previous year, and the net profit was increased from £71 to £2,658, the whole of which was trans-

ferred to reserve. The capital expenditure during the year amounted to £3,187, mains and services (£2,603) accounting for the bulk of this.

Epping.—Electricity Order.—The Rural Council has decided to consent to the application of the County of London Electric Supply Co., Ltd., for an Order to supply electricity to the parish of Chigwell.

India.—The Punjab Electrical Scheme.—The U.S. Vice-Consul at Calcutta reports that there is danger of the Punjab hydro-electric scheme being abandoned unless greater support is forthcoming. It is said that the power requirements of the mills and factories of the State are not sufficiently large to absorb the output.

King's Langley.—New Sub-station.—Owing to a large demand for electricity in the district, Watford Town Council has decided to erect a sub-station there.

London.—L.C.C. Bill.—The London County Council (General Powers) Bill, 1924, contains the following clause: "(M) To enable metropolitan borough councils to use for the purpose of any statutory borrowing powers possessed by them, money forming part of their funds which may be available for the purpose, and to enable any such councils who are electricity undertakers to use any surplus funds arising from such undertakings for the purpose of defraying capital expenditure for electricity purposes."

Hackney.—The Electricity Commissioners have sanctioned the Electricity Committee's proposal to install a 5,000-kW turbo-alternator subject to the Council's agreeing to the linking-up of the Hackney and Islington undertakings. The Islington Borough Council has agreed to lay a .2-sq. in. 3-core, 11,000-V cable as far as the boundary, and the Hackney Electricity Committee recommends that a similar cable be installed from the boundary to the Hackney station at a cost of £12,000. Application is being made to the Electricity Commissioners for sanction to a loan of this amount, and at the same time the Unemployment Grants Committee is being asked for financial assistance.

Maidstone.—Loans.—The Town Council has received the sanction of the Electricity Commissioners to a loan of £2,752 for extending the mains in Loose Road to the borough boundary. The following loans have been applied for:—£1,000 for apparatus to be let on hire; £6,000 for mains; £4,000 for house-service connections; and £2,000 for transformers and switchgear.

Middlesbrough.—Proposed Electricity Agreement.—The Corporation has appointed a sub-committee to negotiate with Stockton Corporation for the sale to that authority of the whole of the rights and interests of the Middlesbrough Corporation in the power station, plant, buildings, and wharf at Stockton. Failing an agreement with Stockton Corporation on a figure for the sale of Middlesbrough Corporation's rights, the sub-committee is to ask the Stockton representatives what suggestion they have to make as to the reserve price to be placed on the wharf, power house, &c., in the event of the Corporation's deciding to put the property up for sale by auction.

Northern Ireland.—Bann Power Scheme.—It has been reported that the Bann electrical power scheme will not be proceeded with at present, and therefore the Bill will not be presented in the forthcoming session of the Northern Ireland Parliament. At a meeting of the Newry Harbour Trust on December 7th, it was agreed that representatives be sent to a proposed conference of public bodies for concerted action against the North-East Electricity Bill.

Belfast.—The Corporation has recommended an alternative system of charging for electricity to private consumers. It is proposed to make a fixed charge of 20 per cent. of the rateable value up to £80, and 10 per cent. of the portion in excess of this amount, plus 1d. per kWh.

Application is being made to the Electricity Commissioners for Northern Ireland for a Special Order, authorising the Corporation to extend its area of supply so as to include the districts of Ballyfinaghy and Ballygammon (Co. Antrim).

Padiham.—Special Order.—The Lancashire Electric Power Co. has applied to the Electricity Commissioners for a Special Order authorisng it to supply electricity within the urban district.

Peterborough.—Loan.—The Town Council has applied to the Electricity Commissioners for sanction to a loan of £15,000 for extensions to the electricity undertaking. The Council has decided not to consider, at the present time, an application by the Marquis of Huntley for a supply of electricity to Orton Hall, as the total expenditure necessary to supply the Hall and village would be £1,370.

Price Reductions.—Reductions in the charges for electricity have been made in the following districts:—

Batley.—Lighting: Flat rate, from 7d. to 6½d. per kWh; sliding scale, from 55½ per cent. to 44½ per cent. above pre-war scale. Power, heating, and cooking: From 80 per cent. above basic scale to 60 per cent. The minimum charge for the summer quarters, from 15s. to 10s.

Eastbourne.—Lighting: From 6d. to 5½d. per kWh.

Birmingham.—Power, heating and cooking: First 300 kWh per quarter, 1½d. per kWh. All energy above this amount, 1¼d. per kWh.

Eccles.—Lighting, power, heating, and cooking: From 50 per cent. to 25 per cent. above the pre-war rate.

Reigate.—Loan Sanctioned.—The Town Council has received the sanction of the Electricity Commissioners to a loan of £15,000 for new plant at the electricity works, this being on account of £26,000 applied for.

Silsden (Yorks.).—Electricity Supply.—The Urban District Council has appointed a committee to make inquiries as to the possibility of obtaining an electricity supply.

Somerton.—Electricity Supply.—The local Council has recommended the Langport Rural Council to consent to an electric lighting scheme being promoted for the district. The consulting engineer is Mr. J. G. Royce.

Southampton.—Year's Working.—The accounts of the borough electricity undertaking (electrical engineer: Mr. W. G. Turner) for the year ended March 31st last show a total revenue of £136,251, as compared with £148,423 in 1921-22. Working expenses amounted to £89,377, as against £96,644, leaving a gross profit of £46,874 (£51,779). After deducting capital charges, &c., there was a net surplus of £5,566, as compared with £1,600 in the previous year. The capital expenditure during the year amounted to £84,860, the chief items being £29,592 for machinery and £38,814 for mains and services. The amount of electrical energy sold increased by 1,611,675 to 10,947,267 kWh, and the connections were increased from 912 to 2,554 kW. During the year the electricity supply was extended to Bitterne and Itchen.

Stirling.—Year's Working.—The accounts of the electricity undertaking (engineer: Mr. W. R. Murray) for the year ended May 15th last show a total revenue of £15,159, as compared with £15,514 in the previous year. Working expenses totalled £10,599 (£10,138), leaving a gross surplus of £4,559 (£5,376). Capital charges absorbed £3,995, and the net profit, transferred to sinking fund, was £568, as against £1,695 in the previous year. The amount of electrical energy sold was 733,980 kWh, an increase of 93,882 kWh.

Swansea.—Mains Extensions.—The Corporation is to extend the mains in various parts of the town at an estimated cost of £10,422.

Tiverton.—Special Order.—The Electricity Commissioners have submitted to the Ministry of Transport for confirmation a Special Order made by them for the supply of electricity by the Corporation within the borough.

United States.—Hydro-Electric Development.—According to *Power*, plans for two hydro-electric schemes, aggregating 115,000 h.p. and costing 10 million dollars, have been announced by the Central Maine Power Co. One scheme involves the building of a dam across the Kennebec River above Lewiston, from which 50,000 h.p. will be obtained, and the other includes a dam across the Kennebec River above Bingham for the development of 65,000 h.p. It is hoped to start construction during 1924.

Urmston and Barton-upon-Irwell.—Special Order.—The Urban and Rural District Councils have applied to the Electricity Commissioners for a Special Order, authorising them to form a joint board for the purpose of supplying electricity in the districts.

Wallasey.—Extension of Supply.—The Town Council has applied to the Electricity Commissioners for powers to give a supply of electricity for public and private purposes to the district of Moreton.

Whitby.—Extension of Supply.—The Urban District Council is to extend its electricity supply to Ruswarp and High Stakesby at a cost of £6,600, and application is to be made to the Unemployment Grants Committee for a grant toward the cost of the scheme.

Wimbledon.—New Plant.—The Borough Council is to install a new 3,000-kW turbo-alternator at the electricity works at a cost of £20,000. Mr. A. E. McKenzie, the electrical engineer, states that the maximum load has increased from 2,500 kW in 1921 to 4,250 at present.

TRAMWAY AND RAILWAY NOTES.

Aberdeen.—New Cars.—The Tramways Committee has recommended that six new double-deck tramcars be built to replace cars which have been in use for over 20 years.

Blackburn.—Proposed New Cars.—The chairman and vice-chairman of the Tramways Committee have been instructed to consider and report on the question of the provision of one-man cars and additional covered cars.

Clitheroe.—Light Railway.—The Rural District Council has decided to support the Longridge to Hellifield light railway scheme. The estimated cost of the scheme is £1,000 per mile, and the Council will contribute £5,500, being the cost of the line in its area.

Continental.—France.—Proposals are under consideration for the introduction of railless cars in the inland districts of France. The Conseil-Général of the Upper Pyrenees has expressed its opinion that it is desirable that a thorough study of such a service should be undertaken by the Department of Roads and Bridges for installation in that province. It points out that this system is economically adapted to districts such as that of the Pyrenees, and has invited the Department to inspect a service already in use at Nimes.

London.—L.C.C. Tramways.—In order to meet the serious diminution in traffic receipts which is apparent from the latest tramway returns, the London County Council has adopted a recommendation of the Highways Committee that the maximum ordinary fare on the Council's tramways be reduced from 6d. to 5d. (with transfers as at present), and that ordinary return tickets, available for one day only, be issued on the following basis:—5d. return for an ordinary single fare of 3d.; 6d. return for a 4d. single fare; and 8d. return for a 5d. single fare.

London United Tramways.—The experimental one-man tramcar, which was introduced upon the Hanwell and Brentford route in November, has justified itself. The car has been running in daily service since, and it is keeping scheduled time with double-deck cars on the route. Further cars of this type are now being constructed, containing additional improvements with regard to loading and unloading, operating mechanism, and added comfort for the passengers.

Nelson.—Track Renewals.—The proposal to abandon the Corporation tramways on the Barrowford section has been rejected, and the Council has decided to seek borrowing powers to relay the track.

Walthamstow.—Proposed Transfer of Tramway Undertaking.—The London County Council proposes to take over the municipal tramway undertaking, and negotiations are proceeding with this object in view.

TELEGRAPH & TELEPHONE NOTES.

Cable Delay.—On the night of the general election, when every available telegraph line and cable was fully required, difficulties arose in connection with the cable service. Owing to trouble this side of Vancouver, the Canadian land lines were thrown out of gear, and as a consequence the Pacific Cable Board's Imperial route to Australia and New Zealand was not available. To meet the difficulty, the Eastern Associated Telegraph Companies dealt with the traffic. They were able to clear up all commercial messages by nine o'clock at night, and thus leave their cables clear to deal with the tremendous load caused by the telegraphing of election results. They used their alternative routes, sending a portion of the dispatches *via* the Cape and the other portion *via* Gibraltar, Aden, and Singapore. In this way both Australia and New Zealand were given the results, and there was practically no delay. The messages were continuous throughout the night. —*Morning Post.*

Canada.—Telephone Statistics.—The Canadian Bureau of Statistics, in a report for 1922, shows that there are 10.53 telephones per hundred of population in Canada. Of the provinces, British Columbia has the highest percentage with 15.19 telephones per hundred of population; and Prince Edward Island has the lowest with 5.80. In 1911, 302,759 instruments were in use; in 1922 the total was 944,029, an increase of 212 per cent. During that time the population of Canada increased by only 21.95 per cent. The number of individual telephone companies operating in the various provinces in 1922 was 2,387, and the revenue for 1922 increased by 7 per cent. over that of the preceding year, the operating expenses were rduced by 4 per cent., and the number of employés by 3 per cent.—*Commerce Reports.*

South Africa.—New Radio Station.—According to *Reuter*, the contract for the radio station to be built at Klipheuvel, 27 miles from Cape Town, has gone to the Durban firm of Messrs. Dougall & Munro, Ltd. The station will be one of the largest in the world, and will have no less than 16 masts of an average height of 830 ft. The contract figure is well towards half a million pounds.

The Telephone Service.—New Camelford Exchange.—A telephone exchange was opened last week in the Camelford district of North Cornwall, and to celebrate the event a dinner was held at which telephonic greetings were listened to through the medium of a loud-speaker.

RADIO NOTES.

Australia.—Low-power Radio Transmission.—The recent series of tests carried out by Mr. Maclurcan, of Sydney, and Mr. Hull, a Melbourne amateur, was commenced, says the *Industrial Australian and Mining Standard*, with an expenditure of about 7 watts, and gradually the power supply was reduced until Mr. Maclurcan was transmitting with 0.078 watt. The signals throughout were clearly received by Mr. Hull. On the following night Mr. Maclurcan succeeded in transmitting code messages which were quite readable in Melbourne (although commercial stations were working) with an expenditure of 0.044 watt. Later the power was further reduced to 0.012 watt, and although some of the signals were received in Melbourne, atmospheric disturbances resulted in others being unreadable. Mr. Maclurcan's measuring instruments were read and checked by independent observers, and were found to be correct within 1 per cent. In view of the success attained, Mr. Maclurcan carried out further work, over longer distances, with Mr. Bell, of New Zealand. Commencing with 0.7 watt, he gradually reduced to 0.04 watt, then to 0.01 watt, and finally 0.0037 watt, and the signals were strong and steady throughout, even on the lowest power. In this case also the instruments were subsequently found to be correct.

Belgium.—Brussels Station.—The Société Belge Radio-electrique was responsible for the construction of, and the installation of equipment in, the Brussels broadcasting station (which was to have commenced a service on November 1st) that is to be operated by the Société Belge de Radio-telegraphie. The Belgians modelled their system on that of the British Broadcasting Co. and the Marconi Co. furnished the apparatus. No licence fees will be charged owners of receiving sets, as the Société expects to profit by the sale of radio sets and the rent of loud speakers to cafés. Cost to individuals for the simplest type of set is estimated at 50 fr. In addition, the Belgian State levies a tax of 20 fr. per year on receiving sets.—*Commerce Reports.*

France.—Broadcasting Regulations.—The French postal and telegraph department announces that the new regulations concerning the use of radio apparatus by the general public will be promulgated within the next few days. In some respects they will be probably more liberal in character than those in force in either Great Britain or Germany, and will, according to the *Morning Post*, allow users to install any kind of appliance they think fit, including those made by themselves. No fee will be demanded by the Government, the only stipulations being that intending users must register their names at the local post office and produce evidence of French nationality. Private users will also be authorised, free of all charge, to install sending appliances for experimental purposes with a pre-determined wave-length.

Radio-Broadcasting.—New Wave-Lengths.—The British Broadcasting Co., Ltd., obtained permission from the Post Office authorities to extend its wave-length band of 350 to 425 metres hitherto in use. Experience has shown that better transmission is possible on longer waves, and the new arrangement came into operation on the morning of December 10th as follows: Aberdeen (2 BD) 495 m.; Birmingham (5 IT) 475 m.; Cardiff (5 WA) 435 m.; Glasgow (5 SC) 420 m.; Manchester (2 ZY) 400 m.; Bournemouth (6 BM) 385 m.; Newcastle-on-Tyne (5 NO) 370 m.; London (2 LO) 350 m.; and the Sheffield relay station 303 m.

L.C.C. School Outfits.—On the recommendation of the Education Sub-committee, the London County Council Education Committee has agreed that, as an experiment for one year, the installation of wireless apparatus in elementary schools should be permitted solely for recreation, outside school hours, provided that the Council's liability be limited to the fee for the annual licence.—*The Times.*

United States.—Broadcast Home Study Courses.—Courses in home study by radio—an innovation which its promoters believe may be of educational value—are to be inaugurated by Columbia University shortly. If an experimental course on the poetry of Robert Browning, which will be broadcast first, proves successful, other courses, embracing English literature and other subjects, will be added to the radio curriculum.—*Reuter* (New York).

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared in our advertisement pages.)*

OPEN.

Aldershot.—January 1st. Electricity Department. 550 yd. 4-core, paper-insulated armoured cable. (See this issue.)

Argentina.—Buenos Aires.—January 21st. Department of Sanitary Works. Steam-driven electrical generating plant, for the waterworks at Posadas.

Australia.—Sydney.—February 25th. Municipal Council. The Department of Overseas Trade states that the date for receipt of tenders for the supply of step-down transformers and induction regulators has been altered from January 14th to February 25th, and that amended specifications have been issued.*

February 11th. Sydney Harbour Trust. Two double-drum horizontal electric capstans. One 5-ton electrically-operated travelling bridge crane.*

Belfast.—March 18th. The Board of Guardians has extended the time for the proposals for central heating and lighting schemes until March 18th, 1924.

Belgium.—December 20th. Municipal authorities of Schaerbeek, Brussels. 25 electricity meters for 190-V alternating current.

Municipal authorities of La Gleize (Province of Liége). Establishment of an electricity distribution system in the town.

December 21st. Municipal authorities of Wimmertingen (Province of Limbourg). Establishment of a low-pressure electricity distribution system in the town. Particulars for 10 fr.

Canada.—Toronto.—January 15th. Mayor and Board of Control. Centrifugal sludge pump, with induction motor.*

January 15th. Electrically-driven air compressor, with accessories, and one separator.*

Cardiff.—January 14th. Electricity Department. One 40,000-lb. water-tube boiler. (See this issue.)

Eastbourne.—January 1st. Electricity Department. H. and l.p. paper-insulated cable. (December 7th.)

Edinburgh.—December 19th. Parish Council. Supply of X-ray and other electro-medical apparatus for Craiglockhart Hospital. Mr. R. T. French, inspector and clerk.

Folkestone.—December 17th. Town Council. Electric lighting work, Fire Station recreation rooms. Chief Officer of the Fire Brigade, borough engineer's office, Church Street.

Halifax.—December 17th. Tramways and Electricity Committee. Coal required during six months, commencing January 1st, 1924, *viz.*:—7,000 tons of washed peas or washed smalls; 8,000 tons of pea slack or 1-in. slack. Mr. W. M. Rogerson, borough electrical engineer and manager, Town Hall Street East, Halifax.

India.—India Store Department.—January 14th. Turbo-alternator set, condensing plant, cranes, boiler, economiser, pumps, steel chimney, pipework, switchboard, motor converter set, rotary converters, sub-station plant, e.h.p. feeder cables, and auxiliaries for new power station and sub-station at Delhi. (See this issue.)

Keighley. — December 17th. Electricity Committee. 5,000-kW turbo-generator and condensing plant. (December 7th.)

London.—London County Council.—December 31st. One three-ton three-motor type overhead travelling crane, one 30-hundredweight motor-driven portable workshop crane for the L.C.C. tramway repair depôt. General manager, L.C.C. Tramways, Victoria Embankment.

Islington.—January 17th. Electric Supply Department. One 5,000-kW, two-phase turbo-alternator, condensing plant, piping, &c. (December 7th.)

Lambeth, S.E.—December 18th. Board of Guardians. Twelve months' supply of incandescent lamps. (December 7th.)

New Zealand.—January 30th. Taranaki Electric Power Board. Generators and switchgear.*

Tauranga.—February 19th. Town Council. McLaren Falls development scheme (contracts for sections 15 to 18). (See this issue.)

Plymouth.—December 20th. Electricity Department. Five e.h.p. switchboard panels. (See this issue.)

Skipton.—Craven and District Private Telephone and Electric Co., Ltd. 1,000 galvanised-iron arms. (December 7th.)

South Africa.—Johannesburg.—January 21st. Municipal Council. 240 tram poles, 5,000 miles of h.d. copper trolley wire.*

Stewarton.—Electric lighting installation for the housing scheme. Plans from Mr. W. Macrae, Town Clerk, Council Chambers, Stewarton.

Stoke-on-Trent.—January 16th. Electricity Department. One 50-ton electrically-driven overhead travelling crane. (See this issue.)

Tullamore (King's County).—December 21st. Tullamore Electric Light and Power Co., Ltd. One 30-kW, 220-V, d.c. generator complete, &c. Mr. S. O'Sullivan, engineer and manager to the company, Tullamore, King's County.

Warrington.—December 17th. Electricity and Tramways Committee. Motors. (November 30th.)

December 17th. Supply of slack for electricity works. Specification, Mr. A. T. Hallaway, Town Clerk, Town Hall.

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—The Brush Electrical Engineering Co., Ltd., has recently secured a contract for four 1,400-kW Brush-Ljungström turbo-generators, with condensing plant, &c., for the Electric Supply Co., of Victoria, Ltd. This is the outcome of the inquiry by the Electricity Commissioners into the extensions of the latter company at its Ballarat and Bendigo generating stations.

Belgium.—Two Belgian, two French, and one Swiss concerns submitted tenders last week to the Belgian Post and Telegraph authorities in Brussels for the supply of bronze wire. The lowest offers were those of home concerns, the Société des Anciennes Usines Montefiore, Anderlecht, being successful as regards 150 tons, and the Société des Usines à Cuivre et à Zinc, of Liége, as regards 30 tons.

There was keen international competition last week for Belgian Post and Telegraph Department cable contracts, offers being received from Belgian, French, Italian, Dutch, Danish, and Czecho-Slovakian concerns and one British firm (Callenders). The Société des Ateliers de Constructions Electriques de Charleroi, submitted the lowest offer for one lot of 200 kilometres; the Nordiske Kabel og Draatfabriek, of Copenhagen, for 12 kilometres of 21-pair-conductor telephone cable and 58½ kilometres of lead-covered cable; and the Société des Cables, of Lyons, for 1,000 metres of paper-insulated and 2,000 metres of lead-covered cable. It may be mentioned that the German offers were quoted in gold francs, and the Czecho-Slovakian in American dollars.

Chesterton.—Board of Guardians. Accepted:—
Installing electric light at the Tramp and Receiving Wards.—Hardy and Sons.

Glasgow.—Tramways Committee. Rails for special track work.—Tenders were received from British and American firms, and the Tramways Committee recommended acceptance of the tender of the United States Steel Products Co., Ltd., at £8,568, this being the lowest offer. Other tenders were:—Hadfields, Ltd., £9,764; Edgar Allen & Co., Ltd., £9,867; and the Titan Trackwork Co., Ltd., £10,031.

It had been recommended by the Sub-Committee on Works and Stores that the contract be distributed among the four firms offering, three of which were British concerns.

Leicester.—Electricity Department. Accepted:—
Extension of generating plant (second section), consisting of four Spearing-type large water-tube boilers for the electricity works.—Vickers-Spearing Boiler Co., Ltd.

London.—Lambeth.—Board of Guardians. Installation of electric lighting on the Brook Street side of Lambeth Hospital. Twelve tenders were received, ranging from £893 to £1,659. The lowest tender, submitted by Messrs. Ellis and Ward, was accepted. The surveyor's estimate for the work was £1,150.

Hackney.—Electricity Committee. Recommended:—
E.h.p. cable and switchgear connecting the power house to the National Projectile Factory, Hackney Marshes (£650).—Disposal and Liquidation Commission.

Maidstone.—Town Council. Accepted:—
200-kVA transformer (£205).—Hackbridge Electric Construction Co.

Montrose.
Electrical wiring and fittings in connection with the erection of an additional wing, &c., at the Montrose Infirmary.—Mr. A. Taylor.

Sheffield.—Electricity Supply Committee. Accepted:—
Two e.h.p. ironclad switchgear panels for sub-stations (£425).—A. Reyrolle and Co., Ltd.

Swansea.—Electricity Committee. Accepted:—
One 10,000-kW turbo-alternator (£35,007).—British Thomson-Houston Co., Ltd.

West Indian Cable Extension.—As mentioned in our "Business Notices" to-day, Messrs. Siemens Bros. & Co., Ltd., have received the contract for 1,700 nautical miles of submarine telegraph cable (Turks Island to Barbados, and thence to Trinidad and British Guiana).

FORTHCOMING EVENTS.

Institution of Electrical Engineers.—Informal Meeting.—Monday, December 17th. At the Institution, Victoria Embankment, W.C. At 7 p.m. Discussion on "Students in Electricity Undertakings."

(North-Western Centre).—Tuesday, December 18th. At the Engineers' Club, Manchester. At 7 p.m. Paper on "Pulverised Fuel and Efficient Steam Generation," by Mr. D. Brownlie.

(Scottish Centre).—Tuesday, December 18th. At the Grosvenor Restaurant, Glasgow. Dinner.

(Sheffield and District Sub-Centre).—Wednesday, December 19th. At the Royal Victoria Hotel, Sheffield. At 7.30 p.m. Paper on "Pulverised Fuel and Efficient Steam Generation," by Mr. D. Brownlie.

Paisley Association of Engineers.—Tuesday, December 18th. At 30, High Street. At 7.30 p.m. *Résumé* of "Atomic Theory," by Mr. W. Acton.

Radio Society of Great Britain.—Wednesday, December 19th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 6 p.m. Annual meeting.

Electrical Power Engineers' Association (N.E. Division, Newcastle Section).—Wednesday, December 19th. At the Connaught Hall, Blackett Street, Newcastle. At 7 p.m. Paper on "Fault Localisation," by Mr. P. B. Addison.

Industrial League and Council.—Wednesday, December 19th. At Caxton Hall, Westminster, S.W. At 5.15 p.m. Annual meeting.

Institution of Production Engineers.—Wednesday, December 19th. At the Engineers' Club, Coventry Street, W.1. At 7.30 p.m. Paper on "Electric Furnaces," by Mr. L. W. Wild.

Birmingham and District Electric Club.—Thursday, December 20th. At the Grand Hotel, Colmore Row. At 7 p.m. Annual meeting.

Edinburgh Electrical Society.—Friday, December 21st. At the Philosophical Institute, 4, Queen Street. At 8 p.m. Apprentices' night for Society Prize.

Manchester Electro-Harmonic Society.—Friday, December 21st. At the Albion Hotel, Piccadilly, Manchester. At 7.30 p.m. Concert.

NOTES.

Million-volt Testing in Germany.—Electrical testing on a large scale at a pressure of a million volts and over is provided for in a factory at Freiburg, in Saxony, where porcelain insulators for the continental market are produced.—*Scientific American.*

A New Dutch X-ray Tube.—An X-ray invention has been made by Dr. Holt and Dr. Bouwers, of Amsterdam. It consists of a new tube which projects a powerful beam of X-rays; in fact, the tube itself is very similar in appearance to a large electric torch. No X-rays emerge from the tube except in the beam, with the highly important result that there can be no danger to the operator. The stream of negative electrons is caused by means of a tiny filament heated to incandescence by an electric current, and this draws rays from the positive anode of the tube in a finely focused pencil. The rays can be directed on any local spot for treatment with the greatest ease, as, in spite of the high pressure, the tube can be held quite safely in the hand.—*Daily Mail.*

Carrier Current Long-distance Lighting.—Experiments made by the General Electric Co. at East Lynn, Mass., proved, according to the *Scientific American*, the practicability of sending high-frequency carrier current, such as is used in radio communication, over electric light feed circuits to light relay lights as far as 4 miles away from the generating source.

Ordinary 110-volt household lighting current was converted into carrier current by means of a high-frequency generator. The output was superimposed upon the 4,400-volt house-lighting feeder current running from the plant to Nahant, Mass., four miles away. Two relays of electric lights at the Nahant end of the line were set to different carrier frequencies. When the carrier current frequency coincided with the attunement of one relay of lights they would light up, but when the carrier frequency was attuned to the other relay its lights would glow. The carrier current was transmitted over the lines without interfering with regular lights. Tests have shown, according to the company, that any number of relays of lights attuned to different carrier current frequencies can be operated individually.

Concert.—The E.T.U. London Station Engineers (No. 1 Branch) will hold their seventh annual concert at the London and Brighton Hotel, Queen's Road Station, Peckham, on Friday, December 21st, at 7.45 p.m.

The Edison Medal.—The *Electrical World* reports that Mr. Thomas A. Edison was present at a luncheon recently at which he met six of the living Edison medallists. Those present were Dr. Elihu Thomson, Mr. Frank J. Sprague and Prof. Michael I. Pupin, Messrs. Benjamin G. Lamme, W. L. R. Emmet, and C. Chesney. The other living medallists, who were unable to attend, are Messrs. Charles F. Brush, John J. Carty, Nikola Tesla, and Robert Andrews Millikan. Three medallists, Messrs. George Westinghouse, William Stanley, and Alexander Graham Bell, are dead. The medal was instituted in 1909, and the award is made by the American Institute of Electrical Engineers.

The World Power Congress.—The General Export Association of Sweden says that Col. F. V. Hansen has been appointed chairman of the Swedish delegation to the World Power Congress to be held in London next year and will report on the power resources of Sweden before Section 1 (devoted to national power resources and their utilisation). Different questions relating to the development of water power will be treated by Chief Engineer A. Ekwall and others; and Professor Hj. O. Dahl will report on the progress made of late in the designing of turbines. Dr. Joh. Ruths will describe his steam accumulator installations, Chief Engineer V. Blomquist the "Atmos" high-pressure steam boiler, and Mr. Fr. Ljungström the air preheater invented by him. The latest Swedish steam turbine designs will be described by experts in this sphere. Professor E. Hubendick is engaged on a report on internal-combustion engines, in which special attention is devoted to the problem of using sulphite spirits as fuel.

In the third section (power transmission) the economic and technical organisation of high-pressure electricity distribution in Sweden will be described by Chief Dir. V. Borgwuist, and the electrification of agriculture by Mr. Nils Ekwall. Other papers touching on this problem will be read by different Swedish authorities.

In the fourth section (general power questions) papers on ball bearings, employment of electricity on farms, and the development of the electrochemical and electrometallurgical industries will be submitted.—*Reuter's Trade Service* (Stockholm).

Electric 'Buses in France.—The first service of electric motor 'buses to be used in France was formally inaugurated recently between Mondane and Lanslebourg. These electric 'buses were actually put into service in August last, but the official opening of the route was postponed until a few days ago. The ceremony was under the presidency of M. Antoine Borrel, Deputy for the Savoy and formerly Under-Secretary of State for Hydraulic Power.—*Commercial Motor.*

Educational.—Lloyd's Register Scholarships.—The Institute of Marine Engineers has issued a pamphlet drawing attention to the examination for three Lloyd's Register Scholarships, for marine engineering students, in May next. Full details of the conditions and subjects of the examination are set forth in the pamphlet.

Electricity on New Zealand Farms.—According to the *Commonwealth Engineer*, the use of electricity in farming operations has made considerable headway in New Zealand. The total number of milking machines in use is 12,468, and the rate of increase is 2,000 per annum. Farmers are beginning to realise the utility and economy of electricity in this direction, and there is great scope for development.

Australian Radio Exhibition.—Dr. Page, acting Prime Minister of Australia, opened a comprehensive radio exhibition in Sydney, on December 3rd, the first of its kind to be held in Australia.—*Daily Telegraph.*

Atmospheric Corrosion.—The first experimental report to the Atmospheric Corrosion Committee of the British Non-Ferrous Metals Research Association will be presented and discussed at a meeting of the Faraday Society to be held on December 17th, at 8 p.m., in the rooms of the Chemical Society, Burlington House, W.1. The very comprehensive series of field tests and laboratory experiments described in the report were carried out by Mr. W. H. J. Vernon, on behalf of the Committee. Persons interested in the subject, and desirous of attending the discussion, may obtain a ticket of admission from the Secretary of the Faraday Society, 10, Essex Street, London, W.C.2.

"Safety First."—Industrial "Safety First" activities have been organised on a national basis since 1918. The application of "Safety First" principles to the problem of public safety, however, has hitherto been undertaken only by isolated bodies in various parts of the country. It is now proposed to weld together into a "National Safety First Association" the two parallel sections. Industrial accidents cost the country £50,000,000 annually, or roughly £1 per head of the population. At least half this amount could be saved by a little care and knowledge on the part of the injured and by the education of children in this subject while at school. That this is not an unfounded assumption is proved by the records of the British Industrial Safety First Association, which are rich in statistics sent by those firms which have adopted its methods. For example, the following table shows the results achieved by a well-known steel-making concern at Sheffield, which joined the Association in 1919:—

	1919.	1920.	1921.	1922.
Number of lost-time accidents	347	210	91	80
Number of lost-time accidents per million hours worked	50	28	30	28
Number of days lost per thousand hours worked	3.05	1.5	1.3	.7
Cost of compensation per £100 of wages bill	13/3	9/4	6/1½	(not available).

A prominent electrical engineering and manufacturing company in the Midlands states that the cost of compensation per £100 of wages has fallen from 9s. 11½d. in 1913 (when "Safety First" work was organised) to 2s. 10d. in 1921. Port Sunlight inaugurated its first campaign in 1907, when the number of reportable accidents per 1,000 employés was 25; at the end of 1921 this number had fallen to six. London manufacturers report that the proportion of total employés compensated varied from 9 per cent. in 1919 to 3 per cent. in 1921 in one case, and in another from 13.76 per cent. to 3.11 per cent. over the same period. Compensation paid to workpeople during 1921 in ten principal industries amounted per employé to: Mines, 40s.; docks, 33s.; engineering and shipbuilding, 21s. 6d.; quarries, 20s. 6d.; metal extraction, 19s.; woodwork, 19s.; construction, 15s. 6d.; railways, 13s.; other metal industries, 9s. 6d.; cotton, 4s. The B.I.S.F.A. accident prevention service costs under 1s. per year per employé, and saves over 40 per cent. of these compensation payments.

Francis Turbines to Operate under 857-ft. Head.—A new world's record will be established for high-head reaction-type hydraulic turbines when the Oak Grove project of the Portland (Ore.) Railway, Light & Power Co. is completed. Construction work is now in progress on a hydro-electric development which will have an ultimate capacity of 100,000 h.p. The first unit, which will be completed early in 1924, will develop 25,000 kW and cost about $10,000,000. The hydraulic turbine for this project, which has just been ordered, will be a 35,000-h.p., 514-r.p.m., Francis-type, single-discharge unit, operating under a head of 857 ft., made by the Pelton Water Wheel Co. It will be similar to the Francis-type turbines at the Kern River No. 3 plant of the Southern California Edison Co., which are of 25,000 h.p. capacity, operating under a head of 810 ft., and have stood as the world's record until now for reaction-type turbines.—*Electrical World.*

A Dutch Cable Ship.—The first cable ship built in Holland has been launched by the Nederlandsche Scheepsbouw Maatschappij at Amsterdam, being intended by the Dutch Colonial Department to serve for the laying and repair of cables in the Dutch East Indies. The ship has a length of 88.70 metres, and the cable machinery is reported to have been supplied by Messrs. Johnson & Phillips, of London.

Communications Conference at Geneva.—The International Communications and Transit Conference has adopted Conventions of which one relates to the transmission of electric power and another to the control of water power in which more than one State is interested. The Conventions remain open for signature by the various States until October 31st, 1924.—*Reuter.*

This Week's Story.—"Your wife needs a change of air." "Doctor, I can't afford to send her away. But I'll tell ye what I'll do. I'll get her an electric fan."—"Quex" (*Evening News*).

Appointments Vacant.—Assistant electrical superintendent, for the South Indian Railway Co., Ltd.; assistant electrical engineer (£480), for the Nigerian Government Railway; chief test-room assistant and assistant engineer, for the Wimbledon Corporation Electricity Department; electrician, for the Cheadle and Gatley Urban District Council electricity undertaking; shift charge engineer for the Walsall Corporation Electricity Supply Department. (See our advertisement pages to-day.)

Public Works Exhibition.—At the Public Works, Roads, and Transport Exhibition promcted under the auspices of the County Councils' Association and held at the Agricultural Hall, Islington, from November 22nd to 29th, the exhibit of Messrs. Electricars, Ltd., consisted of two electric-battery vehicles. The larger refuse-collecting wagon is equipped with Edison accumulators of 300 ampere-hours' capacity, housed under the bonnet, and the frame is built up of ash and steel plates, with solid-drawn tubular steel cross-members. The transmission is effected by two series-wound motors, supported on brackets outside the frame members. They drive the rear wheels independently through internal spur and bevel gearing, the whole of the transmission mechanism running in oil. Ball bearings are used throughout. The tipping gear is electrically operated, giving an angle of from 40 to 50 degrees to the all-steel galvanised body. A patented system of control is used, designed to prevent the possibility of burned contacts. The smaller vehicle shown was of the industrial factory truck type, fitted with a steel tipping body of 50 cu. ft. capacity. This machine is capable of carrying a load of one ton, and embodies an all-enclosed transmission. The battery is of the nickel-iron type.

Messrs. H. C. Slingsby showed an electric battery-driven automatic platform-lifting truck for use in works.

Messrs. Alloy Welding Processes, Ltd.—Electric arc welding appliances, samples of welded work, and various types of electrode.

The Hortmann Gear Co., Ltd.—Automatic lighting appliances, time switches, &c.

Messrs. I. & M. Steingold.—Electrically-driven floor-planing, sandpapering, and polishing machines.

Messrs. Wilson & Perrett, Ltd.—The "Multiweir" electric water recorder, in which, as its name implies, the water passes under a baffle plate and over a number of weirs of equal area. The discharge from one weir is collected alternately in two measuring chambers, while the balance of the water flows direct to the outlet. As soon as a measuring chamber is full, a switch operates the recording instrument, which shows on a chart the gallons passed each hour, and also registers the total number of gallons on a totaliser or integrator, independent of the hourly record on the chart. The recording instrument can be placed either near to or a long way from the measuring apparatus. The counter may be employed to keep a record of any machine where electrical contact can be arranged. For instance, a record of the number of feet or yards of paper passing through a paper-making machine can be kept by arranging a contact on one of the rollers. A contact can be arranged to operate for every stroke of a pump and, given the capacity for each stroke of the pump, a record of the water lifted can be kept, and there are many other applications.

Electric Furnace for Silver Melting.—A rotary electric furnace has been installed by a firm of silver refiners at Sheffield for the melting of silver and nickel silver.

An Arctic Radio Outfit.—An interesting example of the application of radio-telephony is furnished by the record of the second Merton College (Oxford) expedition to Spitzbergen during the period June 14th to September 15th, 1923. It was a private adventure organised by Mr. George Binney, and had for its objects natural history observation, geographical survey, and geological research.

To enable the sledge party to communicate with the ship, it was decided to install a radio transmitting set in the parent ship, and to equip the sledge party with portable receiving apparatus.

The transmitting and receiving apparatus on board was of standard Burndept manufacture, but the weight of the receiving set for the sledge had to be reduced to a minimum; moreover, no facilities would exist *en route* for charging accumulators. Ultimately, a set was designed and made by Mr. E. F. Relf, who was in charge of radio or surveying from the ship, and the apparatus was made to fit the standard sledging food box. A standard three-valve circuit (one h.f., one detector, and one l.f. valve) was employed and standard "Gecophone" components were used exclusively, being presented to the expedition by the General Electric Co., Ltd. The selection of suitable valves presented difficulties. It was anticipated that going would be rough during the greater part of the journey, and standard "R" valves seemed to be indicated from the point of view of mechanical strength. They, however, were ruled out on the score of the weight of the secondary batteries which would be necessary, and it was ultimately decided to install Marconi "D.E.R." dull-emitter valves, for which sufficient energy for filament heating could be obtained from two 22-ampere-hour Fuller "Block" batteries. Actually, they ran the valves whenever necessary during the journey, and were not completely exhausted when the sledge party was ultimately picked up.

The total weight of the receiving apparatus, including the batteries, was only 20 lb.; the aerial consisted of three 7-ft. bamboo poles, which could be fitted together, and an 80-ft. length of wire leading from the top to a short pole 6 ft. high. The lead-in was taken from the higher end, and the earth consisted of a similar length of bare copper wire laid along the ice immediately underneath the aerial. During the whole of the journey, the ship's messages were received with satisfactory clearness whenever the sledge party listened.

Dynamic Model of Valve Oscillating Circuit.—At a recent meeting of the Wireless Section of the Institution of Electrical Engineers Mr. R. C. Clinker, M.I.E.E., described a mechanical model which represents the action of a 3-electrode valve when coupled to an oscillatory circuit. A string moving around pulleys, one of which is driven by a small motor, represents by its motion the current through the valve. The oscillatory circuit is represented by a spring and a weighted pulley. By a mechanical coupling between the spring and a brake on the driving motor, the effect of the intermittent current through the valve is obtained and the system exhibits self-maintained oscillations. A note is added on a "negative resistance" effect obtained with a centrifugal friction governor.

Railway Signalling at Newport.—An extensive power-signalling scheme is to be installed at Newport (Mon.) station, on the Great Western Railway, the contract having been awarded to Messrs. Siemens Brothers & Co., Ltd., London, for the supply and installation of their "one-lever system of route signalling." The contract includes the supply of generating plant and storage batteries at the East and West cabins, the necessary electrical apparatus for working 200 signals and 100 points, and the station limit track circuits with illuminated diagrams at each cabin. This will be the first large installation of this new signalling system. A small trial plant, which was installed at Winchester twelve months ago for the same company, has proved the efficiency of the system. The outside gear, such as point and signal machines, is of a type which Messrs. Siemens have supplied and installed for some time. The great advantages accruing from the operation of a whole route by a single lever are obtained by local circuits in the relay control case of the cabin.

Miners' Nystagmus.—The Ebbw Vale Company, in its efforts to stamp out nystagmus, says the experiment of substituting a canary-yellow tinted glass for the ordinary plain glass of electric safety lamps has proved so satisfactory that arrangements are being made to introduce tinted glass in all its collieries. This simple alteration will, it is hoped, prevent as well as cure a disease from which thousands of miners are suffering.—*Evening News.*

Electric Scaling Hammer.—Recently a demonstration was given at Liverpool, on the Booth liner *Pancras*, of the Sandblom electric scaling hammer, which is especially useful for cleaning corrosion from boilers, ships' plates, &c.

Paris Physics and Radio Exhibition.—An exhibition demonstrating the advance made in physics in general, and radio and electricity in particular, was recently held in Paris at the Grand Palais. The telephone section was particularly complete. One exhibit consisted of a small tank equipped with radio apparatus.—*Reuter.*

The Metric System in Russia.—The Soviet Government has decreed that the metric system shall come into force at once as far as State institutions are concerned; after January 1st, 1927, it will be obligatory throughout Russia.

Motor Ships' Auxiliary Plant.—The last issue of the *Motor Ship* expressed the opinion that, in view of the universal adoption of electric winches on foreign-built motor ships, there was too much conservatism in this country in adhering to steam-driven deck machinery. From two articles in the December issue of the same journal it would appear that the saving to be effected by the employment of electrical machinery on ships is larger than has generally been considered to be the case. In one case a comparison is made of the actual expenditure on a motor ship and a steamer of exactly equal dimensions and similar speed over corresponding routes. During a voyage representing about 100 days at sea, with stops at about 20 ports, the total distance being 23,000 miles for the steamer and 27,700 miles for the motor ship; the former required 1,059 tons of oil fuel for the boiler supplying steam to the auxiliaries, and the motor ship 93 tons for the Diesel generators and electric auxiliary system. Another instance is afforded in connection with 2,000-ton 10½-knot vessels, in which the author calculates that an annual saving of £1,890 is effected by employing electric auxiliaries, the corresponding figure for a 10,000-ton 10½-knot ship being £3,000. Although in the latter case the author may be optimistic, there seems to be no question that the economy in fuel effected by the use of electrical deck and engine-room auxiliaries generally warrants the higher initial expenditure.

Report on Railway Accident.—On July 11th last an explosion occurred in an electric train standing in London Bridge Station (Brighton section of the Southern Railway). The explosion took place in the motorman's compartment of an intermediate coach, and six passengers were injured by fragments of glass. Major G. L. Hall, R.E., reporting upon the explosion to the Ministry of Transport, says that examination of the damaged gear, and the testimony of witnessess, point to the occurrence of three short-circuits. There are very clear indications of short-circuiting in the oil switch, and no evidence whatever of short-circuiting elsewhere, either upon the power or earth side of the switch. The main transformer fuses, rated at only 80 A, remained intact. It is deduced that the earth fault originated in a cracked insulator on the main h.p. switch. The cracks had possibly been in existence for some days, causing a limited discharge which probably carbonised and vaporised the oil in the switch. A surge probably occurred when the bow collectors were being changed over, and caused an explosion in the oil tank of the switch. The oil was examined and found to be satisfactory. Tests of the insulator showed that the material was up to standard, and that any damage was caused by excessive mechanical strain on the interior surface of the insulator.

The inspector recommends that the deep recess type of insulator used should be replaced by the shallow recess type in all stock; that the switch oil gauge should be modified to make the oil level more easily read; also that the ventilation of the h.p. chamber should receive consideration.

An Empire Council of Mining Engineers.—Mr. Hugh F. Marriott, past president of the Institution of Mining and Metallurgy, who has commenced a tour of the British Empire as the official representative of the Institution of Mining and Metallurgy and the Institute of Mining Engineers, outlined to the British Columbia division of the Canadian Institute a plan for preserving the integrity and strengthening the influence of the mining and metallurgical professions. Briefly, the plan is to form an Empire Council of mining and metallurgical societies composed of representatives of all the established organisations throughout the British Empire, which shall be empowered to establish a register of engineers according to such standards of repute and efficiency as it may deem to be expedient.—*Reuter* (Vancouver).

United States Electric Vehicle Market.—The most interesting development in the electric vehicle market during the month ending November 23rd, was the increase in the number of inquiries received by truck manufacturers from firms engaged in industries in which "electrics" have no hitherto been used. Several orders for single trucks were booked, one of which, placed by one of the large petroleum companies, afforded much gratification to the truck manufacturer, who has for years been endeavouring to convince oil companies that "electrics" were more economical than gasoline-propelled vehicles. Among other orders for trucks recently booked were the following:—Laundries, two; bakers, five; coal companies, three; biscuit makers, four. A Chicago truck manufacturing concern, which recently completed an addition to its factory, reports that it now has more orders on its books than at any other period of its history.

The United States Post Office Department has placed orders for 16 electric trucks for use in the transportation of mail in Philadelphia, New York, Chicago, Boston, Detroit, St. Louis, and Washington. Records, showing comparative costs of operation of electric and gasoline-driven vehicles, will be kept for a year. The Insurance Committee of the National Electric Light Association is pressing for lower insurance rates, including fire, collision, and theft, on electric trucks and passenger cars. Insurance companies have already reduced the premiums on these risks, but manufacturers of electric vehicles point out that their products possess so slight an inherent hazard that additional cuts in rates should be made.

According to the monthly summary or foreign commerce for September, there were no exports of electric trucks or passenger cars during that month.—*Reuter's Trade Service* (New York).

Local Societies.—RADIO AMPLIFIERS.—On November 15th, Capt. Hollingworth, M.A., B.Sc., lectured to members of the Manchester Wireless Society on the subject of "Amplifiers." He succeeded in pointing out in a very non-technical manner the several drawbacks which prevent users from obtaining the full percentage of amplification which is in most cases expected. In the lecturer's opinion the greatest enemy of amplifiers and, incidentally, the experimenter was "stray capacity" in the circuit. In the design of transformers (l.f.) the intercapacity action between the windings was far more important than the magnetic flux. Invariably an amplifier would not amplify until it was forced, and then it overdid it to such an extent as to cause distortion. In using three stages of l.f. it was the rule to expect a five-to-one step-up in each case, but it was considered lucky to obtain a maximum total of 25. The only way to obtain more amplification was to employ more h.p. and negative grid bias, and this meant that the l.f. transformers should be of robust construction and of good insulation resistance. Correct grid potential on the rectifier was essential, also the grid leak was a most important factor, and more attention should be paid to the construction of components than to the pretty effect of busbar wiring. The most important circuit of all amplifiers was the resonance or aerial circuit, which should be of the very lowest resistance, and preferably nothing finer than 20 S.W.G. should be used. It was stated that the best reception had been obtained on a single turn of thick wire as aerial coil and a 1 mfd. condenser in parallel—a useful reminder that the theory of large inductance and small capacity was not quite so popular as in the early days.

RADIO-TELEPHONY.—A paper on "Wireless" was delivered by Mr. Norman Turner at a meeting of the Electrical Society of Glasgow on December 4th, 1923, at which Mr. Geo. Morgan, chairman of the Society, presided. The paper was on the lines of a popular talk, the lecturer avoiding technicalities and making free use of the blackboard and a demonstration set to illustrate his points.

FACTORY ELECTRICAL PLANT.—The above was the title of a lecture delivered by Mr. James Walker before a meeting of the Edinburgh Electrical Society on November 20th. The subject was dealt with from many angles, and ranged from prime movers to the smallest accessories. The lecture was well illustrated with a series of lantern slides.

RADIO FREQUENCY.—At a special meeting of the Radio Association of Ireland, held at Dublin, last week, a lecture was given by Mr. J. J. Dowling, M.A., entitled "Facts About Frequency." The secretary, Mr. H. Hodgens, announced that demonstrations of receiving apparatus would be given next month, and that branches of the Radio Association had been formed in the Counties of Cork, Waterford, Limerick and Tipperary.

PRIVATE HOUSE PLANT.—On November 27th, Mr. George Morrison read a paper before the Paisley Association of Electrical Engineers on "Small Private Plant." He dealt fully with the various prime movers used in country house lighting plant, and showed how in some cases the cost of running them would compare with the cost of electricity for lighting from a supply company. The use of batteries was described, and their charging arrangements explained. Particulars were given also of the various systems of wiring, the author stating that he advised the use of the best cable run in screwed enamelled tubing. A discussion followed.—*Paisley Daily Express.*

STORAGE BATTERIES.—Members who attended the November meeting of the Birmingham and District Electric Club heard a lecture on storage batteries by Mr. E. C. McKinnon, A.M.I.E.E. Much valuable information was given in connection with the care of batteries in actual use. It was shown that the many diseases from which they appeared to suffer were caused by ignorance or negligence on the part of the attendant; seldom, if ever, by faulty design. The lecturer did his best to remove the first cause of trouble; but the idleness and carelessness of attendants unfortunately was beyond his influence.

REORGANISATION OF ELECTRICITY SUPPLY.—In a paper which he recently read before the Liverpool Engineering Society, Mr. E. W. Pierce dealt with "The Reorganisation of the Public Supply of Electricity Contemplated by the Electricity Acts, 1919-1922," reviewing the events that led to the passing of the Acts, the appointment of the Commissioners, and the work they had accomplished. In an appendix a list of the electricity districts that have been prescribed and the character of the controlling authorities constituted were given.

At a meeting of the Walsall Engineering Society, November 23rd, Mr. F. Farrar, A.M.I.E.E., presiding, a paper entitled "Electrical Measuring Instruments" was read by Mr. G. E. Duke, Grad.I.E.E., who described in detail the types of instruments in general use, illustrating his remarks with a series of lantern slides, and a large collection of instruments and parts.

Electric Vehicle Trials in France.—The Union of Syndicates of Electricity, in collaboration with the Technical Commission of the A.C.F. and the National Office for Scientific and Industrial Research and Inventions, which arranged trials of electric accumulator vehicles last autumn, has decided to organise a fresh series of trials for the end of September or beginning of October next year, coinciding as far as possible with the 1924 Salon de l'Automobile. Details may be obtained from the Union des Syndicats de l'Electricité, 25, Boulevard Malesherbes, Paris.—*Reuter's Trade Service* (Paris).

INSTITUTION NOTES.

Institution of Electrical Engineers.—INFORMAL MEETING.—At the meeting of the Informal Section, on December 3rd, Mr. J. Coxon was in the chair when Mr. C. M. R. Balbi opened a discussion on "Electrical Aids for the Deaf." The large gathering contained a number of visitors from the Royal Society of Medicine, several of whom provided the practitioner's experiences. Mr. Balbi defined deafness as subnormal hearing, and said it was of two natures: deafness of the outer ear, which could be cured or aided in 90 per cent. of cases, and deafness of the inner ear, which was beyond all known aids. Lantern slides showed the structure of the ear with its series of diaphragms and connections, and he exhibited a few pieces of apparatus designed to aid the deaf, and explained the need for providing indications of the direction of sounds.

Dr. J. A. Fleming, F.R.S., said he was in the unfortunate position of being able to speak from first-hand experience of deafness. It was not sufficiently recognised that instruments had to be devised for the particular types of deafness; further, apparatus for hearing sounds at a distance were not usually adapted for conversation, and he advocated that public buildings, theatres, and churches should have seats wired from a transmitter at the platform or pulpit so that the deaf might "plug in" and be enabled to hear.

Dr. William Hill (St. Mary's Hospital) said that many of the electrical aids produced by his patients were very unsuitable, and he had often found that a broad collector of sound like a trumpet was more effective.

Dr. Sydney Scott said that much was yet to be explained. He knew of cases in which the tympanic membranes were fractured, but the patients were not deaf; the patients could hear, although by present reasoning they should be suffering from deafness.

Dr. F. Thompson described his experiments with radio apparatus on congenital deaf and dumb subjects. They successfully reproduced sounds they had been enabled to hear. Messrs. L. V. Rein, J. W. Wheeler, M. D. Hart, F. S. Robertson, P. G. Pettifor, A. A. Williams, W. Day, and J. Coxon also spoke and Mr. Balbi replied to the questions raised.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Hackney Borough Council Electricity Committee has elected Councillor W. J. Stapleton chairman, and Councillor G. Green vice-chairman for the ensuing year.

Mr. T. Smith, of Newcastle-on-Tyne Electricity Supply Co., has been appointed assistant distribution engineer to the City of Chester Electricity Department.

Mr. A. E. Val Davies, M.I.E.E., &c., who has been associated with the Pretoria Portland Cement Co. during the past few years as consulting electrical engineer, has now opened offices at 77 and 79, Winchester House, Loveday Street, Johannesburg, where he intends practising as an advisory engineer and specialist in power plant. Mr. Val Davies retains his connection with the cement company in an advisory capacity.

Mr. S. P. Ives, for eight years chief electrical engineer to Messrs. Higgs & Hill, Ltd., has resigned his appointment in order to take an active interest in the firm of Messrs. Pinching & Walton, general and electrical engineers and contractors, of 52, Cannon Street, E.C.4, to which address communications should be addressed.

Mr. Percy W. Davis, A.M.I.E.E., has resigned the position of engineer to the Cable Accessories Co., Ltd., Tividale, Tipton, which he has held for the past nine years, and has joined the Credenda Conduits Co. as general manager.

We hear that Mr. A. J. Rayment, head of the technological books department at Messrs. Sir Isaac Pitman & Sons, Ltd., is severing his connection with the company at the end of the year. Pending other arrangements any communications of a personal character may be sent to him c/o. Mr. Theodore Stevens, M.Inst.C.E., M.I.E.E., 50, Lincoln's Inn Fields, W.C.2.

Obituary.—Sir William Mackenzie.—Sir William Mackenzie, president of the Canadian Northern Railway, who passed away last week in his 75th year, was president of the Monterey Railway, Light and Power Co., and the Toronto Railway Co., chairman of the Brazilian Traction, Light and Power Co., the Rio de Janeiro Tramway, Light & Power Co., and other electrical companies; also a director of the Canadian General Electric Co., Ltd., and many other concerns.

Mr. Arnold S. Hughes.—We regret to record the death, which took place at Crieff on December 2nd, of Mr. Arnold S. Hughes, A.M.I.E.E., formerly chief engineer at the Falkirk Corporation Electricity Department. He was educated at the Royal College of Science, and served his apprenticeship with Messrs. Ernest Scott & Mountain, Ltd. On the completion of his apprenticeship he was appointed assistant to the firm's outside superintendent, and in that position he had to do with the electrification of a large number of collieries, the equipment of electric power houses, and the application of electricity to many classes of industry. Two years later (in 1906) Mr. Hughes went to Falkirk and, entering the service of Carron Co. as electrical engineer, he was responsible for the electrification of the company's works, collieries, &c. In 1917 he was appointed chief engineer at the Falkirk electricity works, and he continued in the service of the Corporation until February of this year, when he was compelled to resign his position on account of failing health. He undertook the carrying out of recent extensions, but owing to the state of his health he was unable to see this work completed. Mr. Hughes leaves a widow and young family.

Mr. F. Wheeler.—Mr. Frederick Wheeler, a member of the staff of the Chester Corporation Electricity Works for 27 years, died at Chester last week, in his 52nd year, after a prolonged illness.

Mr. E. A. Hindle.—The death is announced of Mr. Enoch A. Hindle, of St. Annes, who had been in the service of the electricity department for several years and in that of the Council for over 30 years.

Mr. G. A. Moore.—*The Times* records the death, which occurred last week at Brackley, at the age of 66 years, of Mr. George Arbuthnot Moore, A.M.I.E.E., and a member of the Liverpool Engineering Society, who was closely interested in overseas trade matters.

Mr. H. Philbey.—The *Daily Telegraph* "Deaths" column announces that Mr. Herbert Philbey, engineer, Messrs. Callender's Cable Co., passed away at Hove, on December 1st.

Will.—The late Dr. E. K. Muspratt, a director of British Insulated & Helsby Cables, Ltd., and other well-known electrical companies, left £438,466 gross and £430,744 net personalty.

NEW COMPANIES REGISTERED.

The Hydraulic Power and Manufacturing Co., Ltd. (194,225).—Registered as a private company on December 6th, with a nominal share capital of £4,000 in 1s. shares. The articles of association provide that the company shall forthwith create an issue of £60,000 7 per cent. debentures repayable on December 31st, 1933, or earlier at the option of the company, such debentures constituting a first floating charge on the undertaking and assets. The objects are:—To acquire and deal in stocks, shares, bonds, debentures, and securities of all kinds; to adopt an agreement with Ragnvald Blakstad; to construct, maintain, and improve, or aid in, subscribe towards, or lend money for the construction, erection, maintenance and improvement of power supply works, pulp works, railways, tramways, roads, waterways, wharves, buildings, electrical and other works; to acquire water power and rights and concessions in respect of waterfalls, rivers and waterways for generating power, &c. The subscribers (each with one share) are:—W. Pocock, 11, Bowen Road, Harrow, secretary; Miss A. Baldry, 33, St. Andrew's Road, Ilford. The subscribers are to appoint the first directors. No qualification required. Remuneration £50 each per annum and 10 per cent. of the net profits remaining in each year after 10 per cent. dividend is paid. Solicitors: Holmes, Son & Pott, Capel House, New Broad Street, E.C. No notice of situation of registered office was filed at the time of incorporation.

Tubbercurry Electric Lighting and Town Improvement Co., Ltd.—Private company. Registered in Dublin on December 3rd. Capital, £3,000 in £10 shares. Objects: To carry on the business of electricians, electrical engineers, dealers in electricity, &c. The first directors are:—Very Rev. John Canon Gunning, Tubbercurry (parish priest); Edward J. Ormsby, Tubbercurry, merchant; J. A. Flannery, M.D., Tubbercurry; E. J. Gallagher, Tubbercurry; J. C. Burke, Tubbercurry; M. Cunnane, Tubbercurry; M. J. McManus, Tubbercurry; P. J. McDermott, Bunnimadden, Co. Sligo, merchant; P. P. Condon, Cooraclare, Co. Clare, merchant. Registered office: Emmet Street, Tubbercurry.

Gwynedd Trust, Ltd. (194,176).—Registered as a private company on December 4th with a nominal capital of £10,000 in 9,500 7 per cent. cumulative preference shares of £1 and 10,000 ordinary shares of 1s. To carry on business as a hydro-electric, electric, hydraulic and other power supply company; to act as railway and tramway proprietors, financiers, concessionaires, merchants and contractors for public and other works; to transact guarantee, investment and financial business in connection with hydro-electrical and other electrical undertakings, &c. The subscribers (each with one preference share) are:—D. Spencer, The Walnuts, Orpington, Kent, engineer; J. N. A. Houblon, Boxford, Newbury, Berks., engineer. The first directors are:—H. J. Jack and E. R. Davies (both permanent), E. H. F. Reeves, and D. Spencer. The holders of preference shares No. 1-2,000 may appoint any person to be a director in place of the said E. H. F. Reeves and D. Spencer in the event of their ceasing to be directors. Remuneration as fixed by the company. The registered office is at Wellington House, Buckingham Gate, S.W.1.

High Salvington Electric Supply Co., Ltd. (194,237).—Private company. Registered December 6th. Capital, £1,300 in £1 shares. To acquire the electric supply business now carried on by F. R. Cripps and Dorothy S. Cripps at High Salvington, Sussex. The first directors are:—F. R. Cripps, Arcana, High Salvington; Dr. H. J. M. Milbank Smith, Worthing Lodge, Worthing; V. H. Poynter, Furze Holme, High Salvington. Registered office: 21, Chapel Road, Worthing.

Hahn & Co., Ltd. (194,223). Private company. Registered December 6th. Capital, £100 in £1 shares. To carry on the business of manufacturers of, agents for and dealers in electrical apparatus and appliances, including instruments, wires, lands, accumulators, lamps, &c. The first directors are:—J. Axelrad, 25, Mornington Crescent, N.W., merchant; E. C. Given, The Union Club, S.W.1, engineer. Remuneration 20 guineas each per annum. Registered office: 13, Farringdon Road, E.C.1.

Korland Manufacturing Co., Ltd. (194,104).—Private company. Registered November 30th. Capital, £1,000 in 5s. shares. To carry on the business of manufacturers, importers, and exporters of, and dealers in mechanical, electrical, and general machinery, wireless, telegraphic, telephonic, and other machines, typewriters, typing and calculating machines, and all other instruments and mechanisms for lighting, transmitting, recording, calculating, printing, weighing, and impressing, &c. The subscribers (each with one share) are:—S. Leader, 21, Beaufort Mansions, Chelsea, S.W.3, solicitor; K. R. Leader, 21, Beaufort Mansions, Chelsea, S.W.3, law student; Anita E. Innocent, 146, Bedford Hill, S.W.12, secretary. The subscribers are to appoint the first directors. Qualification, 1 share. Secretary (*pro tem.*): K. R. Leader. Registered office: 26, Leather Lane, E.C.1.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Heads (Electrical), Ltd.—A. E. Orbell, of 151/2, North Street, Brighton, ceased to act as receiver or manager on November 1st, 1923.

Salford Electrical Instruments, Ltd. (112,599).—Return dated November 21st, 1923. Capital, £20,000 in 10,000 preference and 10,000 ordinary shares of £1 each. All shares taken up. £10,000 paid on the preference. £10,000 considered as paid on the ordinary. Mortgages and charges, nil.

East Anglian Electricity, Ltd.—Particulars filed of £20,000 debentures authorised August 25th, and covered by trust deed dated November 20th, 1923, constituting a specific charge on certain freehold properties at Stowmarket, Felixstowe, Sudbury, Framlingham and Needham Market, with appurtenances thereto, and building, fixed plant and machinery thereon and a floating charge on the remainder of the company's undertaking and assets, including uncalled capital, the whole amount being now issued. Trustees: H. W. Woodall, Stinsford House, Dorchester; S. F. H. Edwards, 5, St. James Place, S.W.1; and A. H. Seabrook, Potter's Bar, Middlesex.

H. T. Boothroyd, Ltd.—Charge on lease of certain land and works in Bowles Street and Akenside Street, Bootle, dated November 26th, 1923, to secure all moneys due or to become due from the company to the Union Bank of Manchester, Ltd.

Airedale Electrical and Manufacturing Co., Ltd.—Debenture charged on the company's undertaking and property, present and future, including uncalled capital (subject as to the real estate to any prior mortgage thereof) dated November 28th, 1923, to secure all moneys due or to become due from the company to the Bank of Liverpool and Martins, Ltd., not exceeding £650.

Radio Stocks, Ltd.—Debenture dated November 22nd, 1923, to secure £3,500, charged on the company's undertaking and property, present and future, including uncalled capital. Holders:—E. H. Hawkins, 4, Charterhouse Square, E.C.; and H. Ford, 30, City Road, E.C.

Satisfaction in full on November 22nd, of debentures dated March 9th and September 24th, 1923, securing £1,000.

Astro Electric, Ltd.—Particulars filed of £2,000 debentures authorised November 8th, 1923, charged on the company's undertaking and property, present and future, including uncalled capital, the amount of the present issue being £1,000.

CITY NOTES.

Edison Swan Electric Co., Ltd.

The directors report that the trading results for the year ended June, 1923, were satisfactory, the accounts showing a profit of £71,162, after making provision for redemption of debenture stock to the extent of £7,003. It is recommended that the profit be applied as follows: 7½ per cent. dividend on preference shares, £7,500; 7½ per cent. dividend on ordinary shares, £14,358; transfer to reserve fund, £30,000; leaving to be carried forward (subject to corporation profits tax) £19,304. It will be remembered that the company carried through a scheme of capital reduction in July last. The details appeared in our issue of June 29th, 1923, p. 1,027, and the meeting approving the scheme was reported in the ELECTRICAL REVIEW for July 6th, p. 26.

Barbados Electric Supply Corporation, Ltd.

The trading profit for the year ended June, 1923, was £8,413, as compared with £5,686 for the previous year, and £5,272 for the year ended June, 1921. After charging general expenditure in London, debenture and loan interest and a reserve for taxation, the total amount remaining at the credit of profit and loss account (including £1,022 brought forward) is £6,591. Of this amount £4,000 has been transferred to depreciation reserve account, and £2,591 is carried forward. £1,200 has been charged against trading for repairs and renewals, as compared with £2,549 in the previous year. The number of consumers connected increased during the year from 2,395 to 2,665, but the connections (25 c.p. equiv.) only advanced from 29,524 to 29,634. We understand that the reason for this is that a power consumer went off, probably temporarily, during the year. Capital expenditure during the year was £4,276, consisting of additions to the power station buildings and to house connections and mains.

French Companies.

The *Compagnie Le Fill Dynamo*, of Lyons, after having made provision for depreciation, records net profits of 179,000 fr. for 1922-23. It is proposed to pay a dividend at the rate of 10 fr. per share, this contrasting with 6 fr. in the previous year.

The *Société Industrielle des Téléphones* reports profits of 7,718,000 fr. for 1922-23, as compared with 7,375,000 fr. in the previous year, permitting of an increase in the rate of dividend from 45 fr. per share in 1921-22 to 50 fr. for the past year.

The *Compagnie des Appareillages Electriques Grivolas*, of Paris, reports a loss of 1,716,000 fr. for the year ended with last March, thus increasing the total deficiency to 4,680,000 fr. Despite the unfavourable results for the past year, the auditors state that the company remains in a sound position.

The *Etablissements Industriels de E. C. Grammont et de Alexandre Grammont*, reporting on the cable department for the past year, state that the company has obtained the contract for the Marseille-Philippeville cable, which it is hoped to lay next spring. In addition, a large share has been secured in orders for interurban telephone cables with Pupin coils. The net surplus available for distribution for 1922-23 amounts to 3,845,000 fr., which sum, after having written off the loss in the previous year, permits of the payment of a dividend at the rate of 4 per cent. on the ordinary shares.

The *Société Electrique du Toulois* has sanctioned the payment of a dividend of 40 fr. per fully paid-up share and 21.25 fr. per partly paid-up share, free of tax.

Having earned a profit in its financial year of 1,293,516 fr., the *Compagnie Auxiliare d'Electricité de Nantes* has set aside 1,062,500 fr. to distribute a dividend of 24 fr. net, 180,365 fr. being carried forward. An offshoot of the company, the Société Nantaise d'Eclairage et de Force, has likewise realised a net profit of 1,984,950 fr., and has distributed a dividend of 12.35 fr. to the priority shares, 15 fr. to the ordinary shares, and 5 fr. to the *parts bénéficiaires*.

The extraordinary meeting of the *Société Electro-Câble* passed the accounts for the year ended June 30th last, and after setting aside 1,273,030 fr. for sundry sinking funds, sanctioned from the balance of 3,098,110 fr. dividends of 40 fr. per priority share and 25 fr. per ordinary share. The company's business has been distinctly prosperous in the past year, the total income rising from 32,057,000 fr. to 42,425,000 fr., and orders on the books total 38,756,072 fr. The company has built a telephone and armoured cable factory at Argenteuil, having acquired land for the purpose, which is in course of equipment, and expect to start business in this new line in January.

An ordinary meeting of the *Maison Bréguet Co.* has sanctioned from the net profits of the year of 1,632,592 fr. a dividend of 60 fr., a portion of which has already been paid in advance. The new works at Douai were completed in May last, but the company has been compelled to set aside 800,000 fr. for the building of houses for its staff, owing to the dearth of houses. These and other outlays have been met by the proceeds of the 6 per cent. bonds issued in December, 1922, these being guaranteed by the State war indemnity of 5,500,000 fr.

The *Compagnie Générale d'Electricité*, of Paris,, records net profits of 9,429,000 fr. for the year which terminated on June 30th, 1923, or 343,000 fr. in excess of those earned in the preceding year. It is proposed to maintain the rate of dividend at 60 fr. per share, as in 1921-22.

The *Société d'Electro-Metallurgie de Dives* has declared a dividend for 1922-23 at the rate of 60 fr. per share out of net profits amounting to 4,585,000 fr. Although business was restricted during the early months of the past year the directors state that matters have improved, although the company has not yet been able to recover the volume of transactions which obtained in the pre-war period.

The *Compagnie Générale Electrique*, of Nancy, reports a loss of 2,419,000 fr. in the year ended June 30th, 1923, which is attributed to the general difficulties resulting from the present crisis and the development of new works or participations, which involved expenses higher than had been foreseen. The company has now taken over a works in Paris devoted to the production of electrical apparatus, hitherto owned by the Société Metallurgique Electrique.

An extraordinary meeting has been called to accord provisional approval to a proposal to acquire from La Métallurgique Electrique an establishment in the Rue Saint Charles, Paris, specialising in the manufacture and sale of electrical apparatus. The consideration for the transaction is 10,000 500-fr. shares of the former company, plus 5,000,000 fr. for raw and manufactured material, paid down in cash.

The *Société d'Electricité de Paris*, after having written 2,800,000 fr. off first establishment charges and placed 3,600,000 fr. to the renewal fund, reports net profits amounting to 5,651,000 fr., permitting of the payment of a dividend at the rate of 40 fr. per share. The report states that the extensions and renewals at the Saint Denis works were being continued, the consumption increased by 25,000,000 kW hours, and further progress has been recorded in the first five months of the new financial year.

The ordinary meeting of the *Société des Accumulateurs Electriques* (Anciens Etablissements Alfred Dinin) approved the accounts for the year to June 30th last, which showed a creditor balance of 1,987,251 fr. After allotting 808,448 fr. to sinking fund and 94,200 fr. for tax on profits, a net balance of 1,084,602 fr. resulted, from which a dividend of 6 ft. per old share was sanctioned. The business total having greatly increased, the board decided, at the end of the working year, to carry out a programme of extensions calculated to conduce to a large expansion of business.

The *Compagnie Electro-Mécanique*, at its meeting on October 11th, decided to raise its capital from 60,000,000 to 70,000,000 fr., by the issue of 20,000 500-fr. shares at the quotation of 550 fr.

Italian Companies.

The Società Elettrica alto Milanese, of Buoto Arsizio (capital 1,600,000 lire), closed its working year with available net profits of 2,718,714 lire, from which a dividend of 14 lire per share was sanctioned.

The *Società Elettrica del Pellino*, of Borgomanero, registered on the financial year to June 30th a net gain of 168,174 lire, from which a dividend of 3.75 lire per share was distributed.

The *Società Elettrica Bacini Montani*, of Leghorn, has under consideration the increasing of its capital from 100,000 lire to 1,000,000 lire.

The ordinary meeting of the *Dinamo Co.*, of Milan, passed the accounts, showing a net balance of 1,835,000 lire. The year's working had been burdened by the need for resorting to the use of steam and by having to obtain outside supplies of current. After placing 91,751 lire to the credit of the ordinary reserve a distribution of 6.50 lire per share on the 30,000,000 lire capital was made.

An extraordinary meeting, held at Rome, has had under consideration the placing in liquidation of the *Società Italo-Americana di Elettricità*, a company interested in South American enterprise.

Stock Exchange Notices.—The undermentioned have been ordered to be officially quoted :—

Calcutta Tramways Co.—11,950 ordinary shares of £1 each, fully paid, Nos. 688,651 to 700,000.

City of London Electric Lighting Co.—£100,000 four and a-half per cent. second debenture stock, redeemable.

Power Securities Corporation.—500,000 seven per cent. cumulative participating preference shares of £1 each, fully paid, Nos. 1 to 500,000.

Rangoon Electric Tramway and Supply Co.—£200,000 five per cent. mortgage debenture stock, redeemable.

Tokio Electric Light Co.—£3,000,000 six per cent. sterling bonds, Nos. 1 to 2,000 of £50; 2,001 to 13,500 of £100; 13,501 to 15,500 of £500; and 15,501 to 16,250 of £1,000, in lieu of the scrip now quoted.

Isle of Thanet Electric Tramways & Lighting Co., Ltd.—Total receipts for the year ended September 30th, 1923, were £119,972. Balance at credit of revenue account, £40,611. According to the *Financial Times*, it is proposed to place to reserve £10,000 (increasing it to £40,000), to permanent way reserve £10,000 (raising it to £50,000), to rolling stock reserve £5,000 (making it £30,000), to write off £2,500 from cost of motor vehicles, and to pay a further nine months' dividend on preference shares from October, 1909, to July, 1910, making 6s. 3d. per share paid for the year, leaving £7,486 to be carried forward. Loans have been reduced from £34,800 to £27,800.

Venezuela Telephone and Electrical Appliances Co., Ltd.—Presiding at the annual meeting on December 4th, the chairman (Mr. J. S. Austen) said that after providing for the debenture redemption fund and depreciation, a sum of about £10,000 remained. Although this only enabled a dividend of 5 per cent. to be paid, it was not an unsatisfactory result. Although war taxation had affected the company severely, the difficulties were being surmounted and the profits continued to improve. The strength of the Venezuelan currency and exchange was a factor in the company's success.

Parsons Foreign Patents, Ltd.—Net profit for the year ended June, 1923, £6,907. Dividends of 4½ per cent. on the ordinary shares and 2s. 3d. per share on the deferred shares; carrying forward £3,525.

International Light and Power Co.—The directors have declared a dividend of 3 per cent., less British income tax, on account of arrears of dividend on the 6 per cent. preference shares for the half-year to June 30th, 1921.

Melbourne Electric Supply Co., Ltd.—Final dividend on consolidated ordinary stock of 5 per cent. actual, free of British tax, making 10 per cent., tax free.

Power Gas Corporation, Ltd.—Profit £14,197, plus £10,858 brought forward. To reserve, £2,000; dividend, 4 per cent., less tax; carried forward, £11,070.

Pinchin, Johnson & Co., Ltd.—Dividend at 6¼ per cent. per annum, less tax, on the preference shares for six months ending December 31st.

Waygood-Otis, Ltd.—Interim dividend on the ordinary shares at the rate of 5 per cent. per annum.

STOCKS AND SHARES.

TUESDAY EVENING.

INSTEAD of politics being laid on one side, as everybody had expected would be the case after the General Election, they still bulk largely in the public eye, and continue to cast impediments in the way of any revival in Stock Exchange business. The unexpected success of the Labour party at the polls brought about a general flatness when the figures became known. A feeling of depression prevailed that was reflected not only in gilt-edged securities, but in Home Railway stocks and a number of industrials. A feeble effort was made to dissociate the shares in such companies as are likely to benefit from Free Trade, from others that stood to derive more advantage from Protection, but the effort lacked energy, and the general tendency has been for everything to give way.

Electricity supply shares, together with those of the companies connected with the manufacturing part of the business, have escaped lightly, the movements on the week being insignificant and in some cases showing improvements. The declaration by Edisons of a 7½ per cent. dividend on the 4s. ordinary shares, together with the payment of a full twelve months' dividend on the preference was considered as an excellent achievement. It had no particular effect upon the prices of Edisons, but led to a slight improvement in General Electrics, and one or two others of this class.

All the enthusiasm which lately has been displayed over Underground Electric issues became deflated as a result of the General Election. Metropolitan and Districts fell heavily, in company with stocks in the steam lines. The uncertainty prevailing with regard to the disposition of political parties was the principal reason for this flatness. Nobody wants to buy much stock while the outlook remains obscure. On the other hand, people with good profits on their purchases have been trying to sell, and that was none too easy on several occasions, though the markets rallied from the weakest prices touched on Friday last.

The success of the Labour party at the polls was quoted as the main reason for the heaviness, because, although the Capital Levy cannot be a plank in the next Government's platform, and nationalisation as a factor in practical politics becomes removed to a later period, the fear of both lurks in the minds of investors as having come nearer. Moreover, it is considered that the boards of the various Home Railway companies are likely to be influenced in their decisions as to the forthcoming dividends by this consideration, and that in consequence the January distributions may not be as liberal as some people had been hoping. No doubt a good part of the slump was caused by sentiment rather than by realisations; when markets take a definitely cheerful turn, we shall be told that there is no stock about, as has happened so many times before.

Private information claimed to be correct in prophesying that by the end of the present week both the Charing Cross and the Westminster Electric Supply companies would be announcing their arrangements for taking such preliminary steps as will lead to the sub-division of their present £5 shares into others of the more popular £1 denomination. It may be on the strength of this that Charing Cross rose to 13¼. The electric lighting list as a whole is as firm as ever. Although most departments of the industrial section gave way sharply on the publication of the electoral figures, the electricity supply list did not move an eighth from one end to the other. The obvious inference is that shareholders in this industry are too sensible to be moved by the speculative possibilities which have aroused apprehension elsewhere. It is interesting to observe, incidentally, that Welsbach shares fell heavily in consequence of the impression that the appeal to the country meant Protection, in this country, being thrust upon the background for a good many years to come. Iron, steel and kindred issues weakened appreciably, on selling from the North, where investment appears to have received something of a shock, although the heaviness of industrials as a whole no doubt had its reflex action upon the iron and steel department.

Mexico, like man, appears to have been born unto trouble as the sparks fly upward. The latest news, arriving just at the time when a settlement of the country's financial difficulties was on the point of conclusion, states that fresh insurrectionary trouble has broken out. The President is in the field against the rebels, and the faint improvement which stirred Mexican prices a month ago has given way to flatness and stagnation. Nobody wants to do anything in the present condition of affairs, and, while there has been no pressure to sell, there is equally no purchasing power to support the markets in Mexican utilities. Therefore the prices are from 1 to 5 points lower. Brazilian Tractions have been tolerably strong, though the best prices were not held, and other issues in the foreign traction and tramway market show little alteration on the week.

Cable stocks continue the recovery induced by the peaceable speech of the chairman at the recent Marconi meeting, though the advance was checked by the *malaise* which spread through all the markets of the House. Eastern Extensions and Eastern ordinary are better. A rise of 5s. in Great Northern Telegraphs raised the price to 28¼. Marconis weakened a trifle, but Radio Corporations have been good, further American buying taking place and causing both the ordinary and the preferred to spurt, the present prices being 18s. and 17s. 6d. respectively. Canadian Marconis keep dull at 6s., in consequence of the report. Telegraph manufacturing shares are steady. Rubber shares have further sagged, the commodity-price going back to 1s. 2d. per lb.

The recently-issued stocks and shares connected with electricity have not moved appreciably during the political crisis. London Electric Railway and City & South London 4½ per cent. second debentures have drooped to 1¼ discount. The new Bournemouth & Poole ordinary shares, which touched 3s. 9d. premium, fell back a couple of shillings, but rallied to 2s. 3d. premium. Tata 4½ per cent. debentures, Government guaranteed, stand at 2¼ discount, and the 7½ per cent. debentures at 2 discount. At the close of business on Tuesday, a slightly better tone developed, in consequence of the statement that Mr. Baldwin will remain in office for at any rate a month.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Nom.	Dividend. 1921.	Dividend. 1922.	Price Dec. 11, 1923.	Rise or fall.	Yield p.c.
Brompton Ordinary	£ 1	12	12	23/8	—	£5 16 8
Charing Cross Ordinary	5	9	14	13½	+ ½	5 7 8
do. do. do. 4½ Pref.	5	4½	4½	4⅞	—	5 4 4
Chelsea	1	6	10	97/-	—	5 11 1
City of London	1	14	15	49/6	—	6 1 2
do. do. 6 % Pref. ...	1	6	6	24/-	—	5 4 4
County of London	1	8	10	2⅛	—	4 16 10
do. do. 6 % Pref. ...	1	6	6	23/3	—	5 8 3
Edmundson's Ordinary	3	Nil	7	4½	—	5 1 10
do. 6 % Pref	5	12/-	6	5½	—	5 14 3
Kensington Ordinary	5	10	12	10½	—	5 18 5
London Electric	3	4	10	4½	—	6 1 7
do. do. 6 % Pref. ...	5	6	6	5½	—	5 9 1
Metropolitan	1	7	8½	34/-	+1/6	5 0 0
do. 4½ % Pref.	1	4½	4½	17/6	—	5 2 10
Newcastle-on-Tyne Ordinary ...	1	Nil	2½	15/6	—	3 4 6
do. 5 % Pref. ...	1	5	5	15/9	—	6 7 0
do. 7 % Pref. ...	1	7	7	23/-	—	6 1 9
Notting Hill 6 % Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6 % Pref. ...	1	6	6	26/-	+1/-	5 4 4
Urban Ordinary	1	Nil	—	17/-	—	Nil
do. 5 % Pref. ...	1	2½	5	⅛	—	6 17 0
St. James' and Pall Mall ...	5	12	14½	11⅜	+ ½	6 4 9
South London	1	7	10	1⅛	—	5 3 3
South Metropolitan Pref. ...	1	7	7	24/6	—	5 14 3
Westminster Ordinary	5	10	12	10⅞	+ ⅛	5 17 8
Whitehall Elec. Invst., 7½ % Pf.	1	7½	7½	20/3	+3d.	7 8 2

Home Rails.

Central London Ord. Assented	Stock	4	4	73	—	5 9 7
Metropolitan	,,	2½	3½	74½	−2	6 14 0
do. District	,,	1	3	56	−1	5 7 3
Underground Electric Ordinary	10	Nil	Nil	8½	− ½	Nil
do. do. "A" ...	1	Nil	Nil	9/-	−1/-	Nil
do. do. Income	Bonds	4	5	101	—	*4 19 0

Telegraphs and Telephones.

Anglo-Am. Tel. Pref.	Stock	6	6	109½	—	5 15 11
do. Def.	,,	1½	84/6	28½	—	6 9 0
Chile Telephone	5	6	6	6	—	5 0 0
Cuba Sub. Ord.	10	7	7	7½	—	9 13 2
Eastern Extension	10	10	10	16⅝	+ ½	5 19 3
Eastern Tel. Ord.	Stock	10	10	167½	+1	5 19 5
Globe Tel. and T. Ord.	10	10	10	17⅜	—	5 15 1
do. do. Pref.... ...	10	6	6	11½	—	5 7 7
Great Northern Tel.	10	24	22	28½	+ ½	7 16 0
Indo-European	25	10	7	32½	—	*5 7 8
Marconi	1	25	15	2½	—	6 13 4
Oriental Telephone Ord. ...	1	12	12	1⅝	—	*6 8 0
United R. Plate Tel.	5	8	8	6⅝	—	*5 16 4
West India and Panama ...	10	Nil	Nil	1/-	—	Nil
Western Telegraph	10	10	10	10½	—	*6 1 3

Home and Foreign Trams, &c.

Anglo-Arg. Trams. First Pref.	5	5½	12½	8½	—	8 16 0
do. do. 2nd Pref.	5	Nil	5½	3½	—	9 16 0
do. do. 5% Deb.	Stock	5	5	70	—	6 11 7
British Electric Traction Ord.	,,	4½	5	70	—	7 2 10
do. do. 6% Pref.	,,	6	6	98½	—	6 1 10
Brazil Traction	100	Nil	4	46	+1	8 14 0
Brit. Columbia Elec. Rly. Pos.	Stock	5	5	84½	—	5 18 4
do. do. Preferred	,,	5	96/-	84½	—	*5 18 8
do. do. Deferred	,,	3	127/-	98½	—	*3 8 6
do. do. Deb. ...	,,	4½	4½	77½	—	5 9 8
Lond. & Sub. Trac. 5 % Pref.	1	3½	5	8/-	—	12 10 0
London United Tram. Deb. ...	Stock	4	4	59	—	6 13 4
Mexico Trams. 5 % Bonds ...	—	Nil	Nil	72½	−3	6 18 0
do. 6 % Bonds ...	—	Nil	Nil	51½	−1	Nil
Mexican Light Common ...	100	Nil	Nil	20	−5	Nil
do. Pref.	100	Nil	Nil	50	−2½	Nil
do. 1st Bonds ...	—	Nil	5	65½	−2	7 12 5

Manufacturing Companies.

Babcock & Wilcox	1	15	20	21	− ⅛	*4 9 1
British Aluminium Ord. ...	1	10	5	19/6	+9d.	5 2 7
British Insulated Ord.	1	15	15	9⅛	− ⅛	6 0 0
Callenders	1	15	15	49/6	—	6 1 2
do. 6% Pref.	1	6½	6½	26/-	—	5 4 0
Crompton Ord.	1	10	5	½	—	10 0 0
Edison-Swan	1	10	Nil	8/-	—	Nil
do. do. 5% Deb.	Stock	5	5	67½	—	7 8 2
Electric Construction	1	10	10	29/6	—	6 15 7
English Electric	1	8	5	18/-	—	5 11 1
do. do. Pref.	1	6	6	19/6	—	6 8 1
Gen. Elec. Pref.	1	6½	6½	22/6xd	—	5 15 7
do. Ord.	1	10	5	1	+3d.	5 0 0
Henley	1	15	15	49/3	+6d.	6 3 0
do. 4½ Pref.	5	4½	4½	4½	—	5 2 10
India-Rubber	1	10	—	15/9	+9d.	*6 7 0
Mat.-Vickers Pref.	3	6	6	23	− ⅛	5 19 6
Siemens Ord.	1	10	10	17/-	−6d.	Nil
Telegraph Con.	13	20	20	34½	− ½	*5 3 0

*Dividends paid free of Income Tax.

MARKET QUOTATIONS FOR CHEMICALS AND METALS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances.

CHEMICALS, &c.	Price Dec. 12.	Fortnight's Inc. or dec.
a Acid, Oxalic ... ... per lb.	3½d.	½d. dec.
a Ammoniac, Sal ... ... per ton	£60	...
a Ammonia, Muriate (large crystal) ,,	£52	...
a Bisulphide of Carbon ... ... ,,	...	...
a Borax ... ... ,,	£35	...
a Copper Sulphate ... ... ,,	£25 10s.	...
a Potash, Chlorate ... ... per lb.	4d. to 4½d.	...
a ,, Perchlorate ... ... ,,	4½d.	...
a Shellac ... ... per cwt.	£15 15s.	...
a Sulphur, Sublimed Flowers ... ,,	£7 15s.	...
a ,, Roll ... ... ,,	£7 15s.	...
a Soda, Chlorate ... ... per lb.	3d.	...
a ,, Crystals ... ... per ton	£5 to £5 5s.	
a Sodium Bichromate, casks ... per lb.	4½d.	
METALS, &c.		
b Aluminium, Ingots ... ... per ton	£115 to £120	...
b ,, Wire ... ... per lb.	1/9 to 2/6*	...
b ,, Sheet ... ... ,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—		...
Grade I ... ... per ton net	£219	£2 inc.
Grade II ... ... ,, ,,	£156	£1 inc.
Grade III... ... ... ,, ,,	£86	£1 inc.
c Brass (rolled metal 7" to 12" basis) per lb.	9½d.	...
c ,, Tubes (solid drawn) ... ,,	1/0 to 1/0½d.	...
c ,, Wire, basis ... ... ,,	10½d.	...
c Copper Tubes (solid drawn) ... ,,	1/1½d.	...
c ,, Bars (best selected) ... per ton	£95	...
c ,, Sheet ... ... ,,	£95	...
c ,, Rod ... ... ,,	£95	...
d ,, (Electrolytic) Bars ... ,,	£88	10/- inc.
d ,, ,, Sheets ... ,,	£145 10s.	...
d ,, ,, Wire Rods ,,	£76	1/- inc.
d ,, ,, H.C. Wire per lb.	9½d.	½d. inc.
f Ebonite Rod ... ... ,,	3/6	...
f ,, Sheet ... ... ,,	3/-	...
a German Silver Wire ... ... ,,	2/3	...
b Gutta-percha, fine ... ... ,,	6/6	...
b India-rubber, Para fine ... ... ,,	1/0½	...
l Iron Pig (Cleveland Warrants) ... per ton	£5 2s. to £5 2s. 6d.	...
l ,, Wire, galv. No. 8, P.O. qual, ,,	£35	...
g Lead, English Pig ... ... ,,	£31 10s.	5/- inc.
g Mercury ... ... per bot.	£9 15s. to £9 15s. 6d.	...
e Mica (in original cases) small ... per lb.	3d. to 3/-	...
e ,, ,, medium... ,,	4/- to 8/-	...
e ,, ,, large ... ,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings ,,	1/2	...
p ,, drawn bars and rods ,,	1/2½	...
p ,, rolled strip & sheet ,,	1/2½	...
p ,, wire ... ... ,,	1/3½	½d. inc.
o Platinum ... ... per oz.	£55	...
d Silicium Bronze Wire ... ... per lb.	1/0½	...
r Steel, Magnet, in bars ... ... ,,	10d.	...
n Tin, Block (English) ... ... per ton	£238 to £238 10s.	15/- to 20/- inc.
n ,, Wire, Nos. 1 to 16 ... ... per lb.	8/9	6d. inc.

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
f James & Shakespeare.
h Edward Till & Co.
l Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Prize Competition.—The fourth Montefiore prize competition, described as that of 1920, was decided on September 30th last, when the jury met under the chairmanship of M. Omer de Bast. Seven papers were submitted, but none was found worthy of the award of the undivided prize of 21,000 fr. The jury unanimously awarded three prizes of 4,000 fr. each, as follows: To M. Fernand Campus, for the graphic calculation of electrical distribution networks; to M. Thielmans, for the calculation, &c., of long-distance transmission lines; and to Mr. V. Karapetoff, for a series of kinematic devices indicating the performance of various types of a.c. motors and other machinery, and for performing computations. Two of Mr. Karapetoff's devices—the "Indumor," relating to the induction motor and the "Blondelion," relating to the synchronous motor—are to be published in the *Bulletin* of the Association des Ingénieurs Electriciens sortis de l'Institut Electrotechnique Montefiore.

The jury expressed regret to observe the tendency on the part of competitors to neglect the physical side of the subjects dealt with and to concentrate on the purely mathematical side. The next competition will take place in 1925, when the prize will be 22,500 fr.

A London Stoker's Bravery.—In a report upon the explosion of a boiler in the Underground Railways power station at Neasden, the Assistant Secretary of the Board of Trade Mercantile Marine Department pays a tribute to the action of a stoker, Mr. William Segram. The explosion was due to the overheating of one of the tubes and Segram attempted to isolate the boiler. The steam, being highly superheated, was invisible, and he was severely scalded about the legs and face.

LOUD SPEAKERS FOR WIRELESS AND OTHER PURPOSES.

A Joint I.E.E. and Physical Society Discussion.

(*Concluded from page* 873.)

Gramophone Acoustics.

The acoustical problems of the gramophone were dealt with by Mr. H. L. Porter, B.Sc., who outlined the work of Mr. P. Rothwell and himself whilst in the service of the Gramophone Co. The gramophone problem is not a question of improving the sound box independently of the recording horn, or of improving the horn independently of the sound box, or of both independently of the room conditions. The combination—and the room must be included—has to be considered as one acoustic system and treated as such.

The gramophone itself has its own peculiar response, which greatly disturbs the carefully graduated tones on the record. The loud responses and the general distortion depend upon the reproducing instrument used.

Relative Importance of Audible Spectrum Frequency Regions.

The relative importance of each frequency region in the audible spectrum and measurements on loud-speakers were discussed by Mr. E. K. Sandeman, B.Sc.

The relative importance of each frequency in the audible spectrum depends on what function of hearing is to be served. There are three essential characteristics of reproduction: (1) intelligibility of speech; (2) naturalness of music and speech; and (3) reproduction of speech at correct volume, which is bound up with the first two requirements and involves consideration of the energy of speech.

In the case of speech the importance of a frequency region, from the point of view of intelligibility, is by no means proportional to its relative importance from energy considerations.

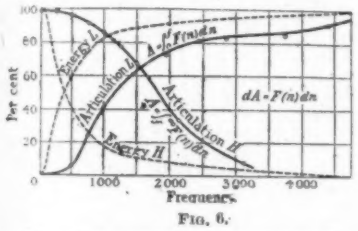


Fig. 6.

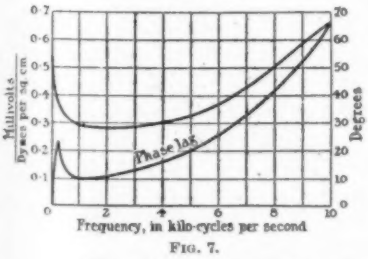


Fig. 7.

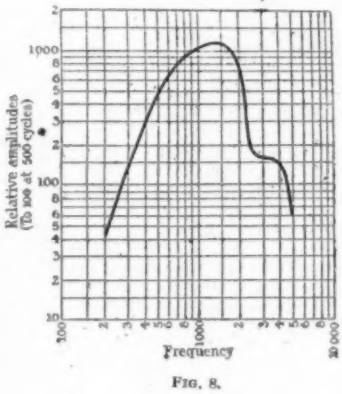


Fig. 8.

Fig. 6.—Effect upon Syllable Articulation and Energy of Speech of Eliminating Certain Frequency Regions.
Fig. 7.—Electrostatic Transmitter.
Fig. 8.—Transmission Characteristics of Loud Speaking.

Fig. 6 shows the effect upon articulation and the energy of speech of eliminating certain frequency regions. The full-line curve sloping up to the right shows the effect on articulation of transmitting only those frequencies below the point plotted, and so is of the form

$$A = \int_0 F(n) \times dn \quad \ldots\ldots (1)$$

where $F(n) \times dn$ is the percentage articulation carried by the frequency region n to $(n + dn)$.

The full-line curve sloping down to the right shows the effect on articulation of transmitting only those frequencies above the point plotted, and so is of the form

$$A = \int_f^\infty F(n) \times dn \quad \ldots\ldots (2)$$

Differentiating we get $\frac{dA}{dn} = F(n) \quad \ldots\ldots (3)$

so that the slope of the curve is a measure of the importance of each part of the spectrum in carrying articulation.

We have assumed that articulation may be expressed as a function of frequency such that the articulation carried by any two regions is the sum of the articulations carried by each individual region. This is actually not the case, since articulation depends on the relative efficiency of reproduction of each frequency region. Hence a discrepancy creeps in if this fact is not allowed for, and practically it is not convenient to do this; actually it will be appreciated from these curves that the error introduced is not serious.

The dotted lines show the energy function in the same way as the articulation. Those frequencies that carry greatest energy are not proportionately important from an articulation point of view. There is as yet no information on the function of frequency portraying naturalness.

The absolute response characteristic of a system (fig. 7) may be defined as a curve plotted between frequency and the efficiency of reproduction at each frequency, this efficiency of reproduction being expressed as the ratio of output to input power, and may be greater than unity.

It is sometimes more convenient to plot the square root of this ratio, and in practice it is more convenient to plot relative instead of absolute response. Fig. 6 shows that if we cut off all frequencies below 500 cycles the effect on intelligibility will not be appreciable, although the naturalness with its more rigid requirements is noticeably impaired. If we eliminate all frequencies above about 1,700 cycles we reach very nearly the limit of commercial speech, and any further considerable reduction in cut off produces speech difficult to interpret. The intelligibility is about the same if we cut off all frequencies above 1,500 cycles as it is if we cut off all frequencies below 1,500 cycles. (By means of Campbell "high pass" and "low pass" wave filters the effect on a loud speaker of eliminating certain frequencies was demonstrated.) As a measure of performance a direct measure of the response characteristic is informative. The most obvious way to do this is by supplying known energy to the loud-speaker and measuring the output sound energy by means of a calibrated microphone in order to obtain a calibration of the loud-speaker. This sounds simple, but difficulty is experienced owing to the production of standing waves. The result is that while the microphone may be situated at what is a node for one frequency or set of frequencies, it may be also at an anti-node for another frequency or set of frequencies, which produces waves in the response curve; a method of eliminating the effect is to take a series of characteristics, moving the position of the microphone slightly each time, and then to draw a mean curve. It is, however, possible by means of suitable damping material on the walls of the room in which the test is made to reduce the effect, and fig. 8 shows a curve obtained by a combination of these two methods, where the damping was only partial.

The effect of nodes and anti-nodes may be avoided to a large extent by making the test in a large room with the microphone placed very near the horn of the loud-speaker, in which case the volume of emitted energy is very much greater than the volume of reflected energy; there is, however, a danger of standing waves being formed between the horn and the microphone.

Another method which has been very successfully used by Mr. L. C. Pocock is to employ a band of frequencies, the frequency applied varying sinusoidally in time between two frequencies at equal distances on each side of the frequency, the response of which is to be measured. Such a method automatically takes an average, eliminating the effect of nodes and anti-nodes and actually tending to prevent their formation.

(The formation of nodes and anti-nodes was demonstrated by connecting a valve oscillator to a loud-speaker.) The intensity of sound varies very considerably from point to point in the room, the nodes being roughly of the order of a wavelength apart, so that the frequency of occurrence of nodes is proportionally greater in the case of high frequencies than in the case of low frequencies.

A loud-speaker must be tested in its associated circuit, but we can make a modification if prepared to make an impedance run, supplying constant current to the loud-speaker at each frequency and correcting for its impedance and that of its associated circuit at each frequency. This is the method generally used, but it would appear to be much quicker in the commercial case to test the loud-speaker in circuit with its associated amplifier, since all correction is thereby avoided.

Diaphragm Overtones.

The overtones of the diaphragm of a telephone receiver were discussed by Prof. J. T. MacGregor-Morris, M.I.E.E., and Prof. E. Mallett, M.Sc.(Eng.), M.I.E.E. Diaphragms in vibration exhibit resonance at various frequencies, and at the frequencies of resonance the vibration amplitude under a given impressed force is greater than at others. The frequencies at which resonance occurs are not harmonic and the resonance occurs by the plate vibrating in portions and not as a whole. (These various modes were exhibited by sprinkling sand on to a diaphragm.)

Many loud-speakers use a vibrating plate and it seems natural to conclude that they must have resonant frequencies which are to be ascribed to the various modes of vibration of the diaphragm. How sharp the resonances are depends on the damping. In the case of the ordinary receiver considerable damping is introduced by the closeness of the ear cap to the diaphragm, and still further damping is introduced when the receiver is placed to the ear. In at least two different types of relatively successful loud-speakers a similar device is adopted to introduce damping.

It would therefore seem to be a question of a judicious balancing of the damping against the resonance. Without the resonance, *i.e.*, with very strong damping, the response would be very poor, but uniformity over the frequency range would be assured. With resonance the response is great, but there is lack of uniformity.

That the frequencies at which resonance occurs with an ordinary diaphragm are within the necessary range in music seems to be certain, as the following table† indicates, and as was heard during the demonstration :—

Experimental Results obtained with a Standard Receiver.

Modes of vibration.	Frequency in periods per second.	Ratio to fundamental.
Fundamental	1,050	1
*1 nodal diameter	1,420 1,630	1.35 1.55
2 diameters	2,250	2.14
1 circle	3,000	2.86
3 diameters	3,400	3.24
*1 circle and 1 diameter	4,000 4,550	3.81 4.34
*1 circle and 2 diameters	5,760 6,150	5.48 5.85
2 circles	6,820	6.50
*2 circles and 1 diameter	8,150 8,600	7.76 8.20

(Those marked * were obtained with one of the receiver coils reversed.)

Auditorium Acoustics.

The subject of auditorium acoustics and the loud-speaker was reviewed by Mr. G. A. Sutherland, M.A. When a source commences to emit sound the energy density has been shown by Jäger, making assumptions as to conditions that are sufficiently close approximations to those actually occurring, to grow according to the equation

$$E = \frac{4A}{avs}\left(1-e^{-\frac{avs}{4v}t}\right)$$

where E is the average energy density at time t, A the energy emitted per second, v the volume of the room, v the velocity of sound, and e the exponential; s is the total surface presented by walls, ceiling, floor, furnishings, &c., and a its average absorption coefficient. If there are surfaces S_1, S_2, S_3, S_4, &c., with coefficients a_1, a_2, a_3, a_4, respectively, then clearly $as = a_1S_1 + a_2S_2 + a_3S_3 + a_4S_4 + \ldots$. Similarly, when the source is stopped the time of decay is given by

$$E = \frac{4A}{avs}\,e^{-\frac{avs}{4v}t}.$$

The value of the maximum intensity attained E_{max}, which is $4A/(avs)$, varies directly with the rate of emission of energy by the source and inversely as the total absorbing power of the room.

If a room be very large, s is large and the maximum intensity can be changed only by varying A or a. Thus it will be impossible to fashion too large a room satisfactorily for sounds of limited strengths.

Rate of growth in a room changes with the average absorption coefficient of its walls, the maximum intensity attained being greatest for an empty room, but the time to attain this maximum is also greatest; the time of decay is greatest for this case also. The intensity rises most slowly in the case of the largest room and also attains the smallest maximum.

In speech, where the emission is discontinuous, at any one instant about 60 per cent. of the sound heard is due to previous syllables and only 40 per cent. to the syllable actually being uttered, also the variation in intensity due to the discontinuous articulation is only a small percentage of the total intensity, conditions which inevitably mean indistinctness.

The effect of speaking at half the rate in the same room is that the maximum intensity is only about half what it was, but the syllable actually being uttered contributes 60 per cent. of this. This represents an improvement, the percentage variation between syllables being 40 per cent., and although the discourse might seem disjointed to the speaker it will not seem so to the audience.

If we take a room of the same size, but of higher absorbing power, the maximum attained may be reduced to one-tenth of the previous value, but each syllable contributes 94 per cent. of the sound heard at any instant, and the variation between syllables is about 45 per cent. of the maximum. This represents a state of affairs in which hearing is satisfactory, and for speech distinctness is more important than loudness.

It is possible to carry the process further, but such a state of affairs is inferior because we are so accustomed to a certain amount of overlapping that a condition in which it is absent seems unnatural, and also because ideally a speaker's utterance should have in it something of the character of music, and everyone would unite in condemning as "dead" a passage of music in which there was no blending of successive sounds.

To the slow decay of sound in a room the name "reverberation" has been given, and the best condition as regards distinctness is associated very approximately with a particular reverberation period which in a room of a given volume has one value for speech, another for chamber music, and a third for orchestral music. A logarithmic curve is completely determined if we can measure the time of decay to $1/e$ of the initial value. In any ordinary room this time is too short to be capable of accurate measurement, and Sabine measured instead the time of decay to inaudibility of a sound initially 10^6 times the minimum audible intensity. This he calls the "period of reverberation." Sound, being a form of energy, cannot be got rid of by the scattering produced by irregularities in the walls, &c. It remains audible until converted either directly by air friction into heat, or into some other form which will eventually become heat. Thus the most effective absorbents of sound are porous linings and furnishings; an audience is the best absorber of sound.

Much more satisfactory hearing is likely to be attained by distributing an audience into a number of small rooms with a loud-speaker in each than by attempting to accommodate all in a large hall. Even if the large hall be full the audience is not so effective in reducing reverberation as in smaller rooms. If the room is partly empty the situation is considerably worse. For music, where a longer reverberation is desirable the opposite arrangement may give the better results. It is impossible to generalise, however; each case would have to be settled on its merits.

Nothing is to be gained by having a loud-speaker with a rate of emission of energy many times that of the human voice. Almost all halls suffer from excessive reverberation and the louder the initial sound the greater is the confusion produced. Clearly the sound heard depends on the relative intensities of the vibrations reaching the audience, but different wave-lengths are far from being absorbed equally.

Generally if the sound from a loud-speaker tends to be too rich in higher-pitched notes, then the presence of a large audience is likely to have a corrective effect. As before, it will be advantageous to use several smaller rooms rather than one large one. The case of music is too complicated for treatment here.

Directions of Improvement.

In suggesting some directions of improvement in the loud-speaking telephone, Mr. S. G. Brown, F.R.S., M.I.E.E., remarked that a loud-speaker consists, among other things, of a diaphragm which operates in an enclosed chamber in the manner of the piston of a pump. A hole is provided in the cover of this chamber, and air is forced in and out through it as the diaphragm vibrates. The smaller the hole, within reason, the greater will be the velocity of the air as it leaves the chamber and, as the sound energy is proportional to the square of the amplitude, the output of the loud-speaker can be materially raised by a suitable size of hole.

This natural vibration of the air column in the trumpet is super-imposed upon the vibrations set up in the air by the diaphragm. It can, however, be removed by drilling suitable holes in the tube along its axial length. The first hole would be mid-way along the trumpet in order to eliminate the natural frequency of the column. The next overtones are removed by drilling holes respectively one-quarter and one-eigth of the way along the axial length, their diameter being smaller as the diameter of the trumpet diminishes. The improvement brought about by this device is recognisable by a trained ear.

As regards the material of the funnel, a rigid wall is desirable for the proper enclosure of the vibrating air column, and to this end it should be of heavy metal and of thick cross-section. If the trumpet walls are too thin, the force of the air expanding as sound will distort them, causing them to resonate.

The vibrations of the diaphragm are not all imparted to the air, but escape into the metal enclosure and thence up the metal of the trumpet. It is therefore a good plan to insulate the sound-producing element from the trumpet and casing. Even the best of modern loud-speakers causes a certain amount of distortion, attributed to the free vibrations of the diaphragm. If we could obtain the necessary air waves with

†Extracted from a paper published in the I.E.E. *Journal* No. 323, October, 1923.

less amplitude of movement at the source, greater freedom from distortion would result. Possibly this might be done by employing a larger diaphragm, suitably stiffened without sacrifice of lightness.

Alternatively, we can produce sound vibrations by other kinds of pressure devices, such as the "Frenophone." (This instrument was demonstrated, being worked in conjuction with a Sterling "Threeflex" valve and crystal receiver and a small frame aerial.)

The Gaumont-Lumière Loud Speaker.

Capt. P. P. Eckersley briefly outlined the characteristics of the Gaumont-Lumière loud-speaker and demonstrated it with the aid of a valve receiver and the Institution aerial. The device is quite different from any of the types made in this country, and it is hardly correct to call it a "loud-speaker," because it is weak and totally unsuitable for use in a large room or hall. Nevertheless, in a fairly small room it would give very excellent results, for it is very pleasing in tone.

Discussion.

Dr. W. H. Eccles, F.R.S., who was the only contributor to the general discussion, pointed out that the loud-speaker proclaimed the dawn of a new age and would revolutionise the science of communication. The human ear was a wonderful thing; at middle age the ear had a range of from 40 to 20,000 vibrations per second and, therefore, if the loud-speaker was to be a sucess it must have the same range. But that was an enormous task and the ear expected very much. Another extraordinary thing was the minuteness of energy that sufficed for comfortable hearing. The Western Electric Laboratories in America had probably done more in that connection than any other organisation in the world. Three things were needed: first, every frequency had to be amplified equally; secondly, the instrument must not introduce asymmetrical distortion; and, thirdly, impulse transmission produced damped trains and must therefore be avoided. Finally, if it was true that the loud-speaker efficiency was only 1/10 of 1 per cent., that was a shocking confession to have to make.

ELECTRIC STRAYS.

By F. CHARLES RAPHAEL, M.I.E.E.

(*Abstract of paper read at the* Public Works, Roads, and Transport Congress and Exhibition.)

Omitting leakage currents from telegraph and telephone circuits, which can cause no damage to pipes or buildings, electric strays may be divided into three categories: (i) In this country the Board of Trade wisely imposed regulations to limit the permissible drop on tramway rails and the potential difference between rails and neighbouring pipes, which have prevented a repetition of the experiences in America and Germany. Districts in which the regulations have been rigidly conformed with have been almost, if not entirely, immune from electrolytic damage, but the quantity of metal removed by electrolysis is (other things being equal) exactly proportional to the time during which the pipes are subject to the action, and as it has not been the duty of the Board of Trade or the Ministry of Transport, its successor, to make periodical inspections and tests, there are districts in which the somewhat technical regulations, although they may have been observed at the start, have been disregarded later, and in such cases electrolysis, if it has not been observed already, is bound to be so sooner or later. On the whole, although a number of well-established instances have certainly occurred, we have been wonderfully free from trouble from this source, but it would be fatal to relax the existing precaution on that account; it is probable that far more electrolytic corrosion of pipes is occurring than is imagined, and that in many cases of pipe renewals the normal corrosion in the ground may have been considerably accelerated by electrolysis without its being known.

The ideal remedy would be to insulate the whole of the pipes throughout their length. This is impossible in practice, but a great deal can be done by seeing that all mains and joints are well bituminised outside. At joints it is best to ensure good conductance by not bituminising the interior of the socket or the spigot end of the pipe, but to let them make as perfect as possible metal-to-metal fit. In general it will be safest to follow the broad rule of keeping the pipes as far away from the tramrails as possible, and of making the pipe system as completely as possible a good and independent conducting network.

In addition to voltage tests between the rail and pipe, the author has obtained useful information by measuring the fall of potential along the pipes. It is possible to deduce from such observations the relative values and direction of the stray current in the pipes, and to compare records taken at different dates to see whether a good electrical condition of the tramway track is being maintained.

(ii) Electrolytic damage due to leakages and faults in ordinary electric light and power mains is unlikely to occur. The author has had to investigate circumstances in which mains of other services have been threatened and, in some cases, actually burnt through by faults in electric cables, but it is only on the practically obsolete systems that trouble is liable to arise. The sequence of events is nearly always the same: A fault occurs in the cable, but the "earth" at the spot is poor; consequently the current selects a path to earth through the nearest gas, water, or telephone pipe, and an arc is set up at the point at which the current flows to the pipe. The arc may occur at some distance from the fault in the main—in one case it was over 200 yd. away.

(iii) Leakages from electrical installations in houses have seldom done any harm to other services. The only cases of damage within buildings that have come under the author's notice were due to the lead covering of the cables, in one case, and the steel conduit containing the wires, in the other case, not being properly bonded and earthed.

Under normal conditions it is extremely doubtful whether there can be any electrolytic deterioration of ferro-concrete at all. The main conclusion is that, if the concerete is wet, conditions for electrolysis exist, but even then a fairly large voltage is necessary to produce it. The presence of sodium chloride or calcium chloride in the concrete, even to the extent of a fraction of 1 per cent., greatly increases the initial electrolytic conductivity of the concrete and also destroys the "passive" condition of the iron in it. The addition of common salt to the water used in mixing the mortar, with the object of lowering the freezing point, is bad practice from the building point of view, as it would retard the drying out of the material; from the electrical point of view it is to be condemned in any case. Assuming absolutely dry material nothing need be feared from electrolysis at all, but it is, apparently, impossible to assume that ferro-concrete is dry, and even then no deterioration could be produced when the iron was acting as the anode (*i.e.*, reinforcement positive to the earth) at temperatures below 113 deg. F. and, in the specimens tested, the potential gradient to produce this temperature was as high as 60 volts per inch—a condition which would not obtain in practice. The action does not take place on the concrete under these circumstances, but upon the iron reinforcement; with the exception of the material immediately surrounding the iron, the concrete is unaffected. The cracking of the concrete immediately around the iron is due to the mechanical pressure which is set up in consequence of the larger volume of the products of electrolysis and oxidation, and not to chemical action on the concrete.

When the current is in the reverse direction and the iron is acting as the cathode (*i.e.*, the reinforcement is negative to earth) the action on the material can be more serious. Very little current will actually pass through the concrete unless salt is present, but with current in this direction so high a voltage is not necessary as when the reinforcement is the anode. In this case the resultant effect is directly on the concrete itself in the immediate neighbourhood of the iron. Metallic potassium or sodium is formed as a product of the electrolysis, and acts directly on the cement surrounding the iron anode and softens it so that the bond between the concrete and the reinforcement is destroyed. A prolonged application of a higher voltage than would obtain in the case of ordinary electric strays through the reinforcement is necessary for this destruction, however.

Therefore, it is evident that there is nothing to fear for buildings merely in the path of stray currents of low voltage, and that there is no risk of electrolytic damage from higher voltage currents if they are detected early, as would be the case with leakages from ordinary electric light and power circuits. On the other hand, if ferro-concrete structures are employed to support the rails of electric railways, there is some risk of the voltages being sufficiently high to start corrosion, but, knowing this, it can be remedied.

The report of the American Bureau of Standards contains a recommendation that, in ferro-concrete buildings, the conduit containing cables used for electric light and power should be insulated at the point of entry to the building. This is contrary to British practice, and introduces risks far greater than the infinitesimal risk of corrosion.

[A progress report issued in September last by a board of engineers engaged in preparing information for the Australian Electricity Commission in relation to reports of damage to ferro-concrete structures in Melbourne due to stray leakage currents, supports Mr. Raphael's contentions; an undeniable example of electrolysis was an exceptional case and unlikely to be repeated, the effect being caused by the fact that the building's steel reinforcement bars were bonded to a brick pier that supported the adjacent electric railway structure.—Eds. Elec. Rev.]

Discussion.

Mr. S. E. Britton, president of the Incorporated Municipal Electrical Association, was in the chair and explained that the I.M.E.A. had been very pleased to do what it could in connection with the Congress, as it had done on previous occasions, by arranging to have papers read.

Mr. S. C. Bartholomew (G.P.O.) said it was stated in the paper that there had been no trouble with the underground railways in London where the fourth rail was being used. The Post Office, however, had had two or three cases in which cables had been damaged. Again, with regard to leakage from electric lighting mains causing electrolysis, the Post Office had had a number of cases where faults had caused the breakdown of telephone cables. The paper stated that such faults could very quickly be discovered, but the fact was that it was the trouble with the telephone cable which first gave the warning that the electric light mains were leaking. In one case, leakage from the electric lighting main had been going on for six months and it was only discovered through the Post Office men getting shocks whilst using shovels and picks. He agreed with the author that there had not been very much trouble in this country until a few years ago, but during recent years, the Post Office had found a disquieting increase in the number of cases. There seemed to be a speeding-up towards the end of the war, and the conclusion come to, was that tramway tracks at that time were not being maintained in proper condition as they would have been in normal times. A factor, in the number of cases appearing to be very large in recent times, might be that the Post Office was using lead-covered cable to a much greater extent. Last year there were 50 cases of trouble from electrolysis requiring investigation, and this year there had been 60 such cases. As a rough estimate, they cost £8,000 to repair, so that it was really a serious matter. There was always the possibility of chemical action on lead-covered cable, but there were very few cases in which there were in the soil constituents likely to attack lead, although this possibility could not be ignored. For this reason, it was the practice of the Post Office always to make a chemical test of what was found in the pits and also of the soil. If PbO_2 or peroxide of lead was found, it was assumed that the trouble was definitely due to electrolytic action because peroxide of lead could only be formed electrolytically. At the same time, it did not follow from the absence of peroxide of lead that electrolytic action was not taking place, because the peroxide disappeared very quickly. As to voltage tests, he did not think that those laid down by the Ministry of Transport were, in themselves, very conclusive. It was very necessary, in the case of electrolysis investigations, to find what current was flowing, and the Post Office had developed a very simple test so far as manholes were concerned. An American engineer had told him that the method of testing for current in the sheathing of cables adopted in this country would be of no use in America because it would entail the carrying about of such a lot of plant. When he told the engineer that it could be done with the aid of quite a small battery, the reply was that the smallest current found in America was 75 amperes. In America they had adopted drainage very largely, more particularly where lead cables were concerned, and they very much doubted the wisdom of connecting the pipes or sheathing of cables to the rails. In Manitoba they had gone to the extent of obtaining a special Act of Parliament dealing with electrolysis and forbidding the connection of pipes to the negative. The same held good in Switzerland. What happened was that if the pipe or sheathing was connected to the negative return it tended to become part of the return system and might then endanger other cables which would otherwise, perhaps, not be affected as had happened in Winnipeg. The best thing was to keep the pipes as far as possible away from the tramways. In a paper before the Institution of Electrical Engineers some years ago the Cunliffes said that 3 ft. was a safe distance, but that had been proved to be not the case, and the recent Swiss regulations had suggested that it was not safe to go within 200 metres, otherwise special precautions would have to be taken. Then a matter sometimes overlooked was that tramway standards were often bonded to the rails for the purpose of guard wires which made the standards part of the rail, and trouble was caused through not taking precautions to protect a cable passing near that point. Whereas, in the case of electric lighting, there was a clause by which the supply authority could be indicted for making a nuisance, there was no such provision in the case of tramways.

Mr. A. Watts spoke of the absence of real evidence that electrolysis was caused by tramways running under the Board of Trade regulations. In 1895, when he was with the National Telephone Co., they were a little concerned in Sheffield as to what was happening with the return current from the tramways, and careful tests were made without being able to find any real evidence of damage.

Mr. Bartholomew assured Mr. Watts that since he had left the National Telephone Co. there had been very many cases of electrolysis, although he believed there were very few in Sheffield.

Mr. E. Worrall (borough engineer, Stretford) said it had been his practice, in order to prevent bridges from being attacked, to asphalte the crown of the bridges and other parts liable to attack. The extra cost was a very good insurance, but he would like to know whether it was necessary.

Mr. A. C. Cramb (chief electrical engineer, Croydon) said that if the Board of Trade regulations, in the case of tramways, were carefully complied with there was very little risk of trouble, but he was equally sure that there was a considerable tendency on the part of the people responsible for track continuity not to do as they ought to. Electricity supply undertakings and the Post Office authorities suffered through this neglect at times. Unfortunately, this work was often in the hands of surveyors. Trouble, too, often occurred where tramway routes crossed, there being a heavy flow of current across the rails from one route to the other if the drop on one route was more than that on another. That pointed to the need for the rails being solidly bound up not only on each route, but right round. There had been, he believed, a certain amount of trouble from electricity supply mains on d.c. systems, but with a.c. systems it was much less than the Post Office seemed to imagine. As to the effect of electrolysis on reinforced concrete structures, quite apart from rapid action, there might be slow action taking place over a number of years which might so reduce the strength of the reinforcement that it would no longer exist. The same might occur with chemical action, but probably it all depended upon the spacing of the reinforcement and the dryness of the concrete.

Mr. W. C. P. Tapper (chief electrical engineer, Stepney) said that owing to the fact that the L.C.C. tramways used an earthed return they caused no electrolytic troubles in his district. Originally, there was a certain amount of trouble due to the fact that the lead was not continuous inside the casing of the cables, but that had been overcome by bonding the lead together with hammered lead sleeves and soldered joints. As to trouble from electric lighting mains, he could not understand there being any if the electricity authorities complied with the Board of Trade regulations, which meant a test twice a day. Under those conditions he could not imagine a leak being allowed to continue for six months.

Mr. F. C. Raphael, replying, said that the testing apparatus he used was a modification of the one adopted by Mr. Bartholomew, and he only carried a 4-volt, 20-ampere battery. He doubted whether the evidence Mr. Bartholomew obtained in some of his cases would be such that he would put it forward as evidence, say, in arbitration. It would be interesting to know in how many cases, too, the Ministry of Transport's regulations—as they now were—had been complied with. In the ordinary way, a person could not recover damages if the regulations were complied with, but the Post Office was in the peculiar position that, if it could prove that any damage was caused by the electricity supply or tramway authority, then it could recover. As to cases on the underground railways, they were not on the tube railways where the tubes shielded the cables, but on the open portion of the Metropolitan railway. He agreed with Mr. Bartholomew that it was dangerous to bond pipes or the sheathing of cables to the rails, and asphalting the crown of bridges would not be necessary in the case of lighting mains unless there was reason to think leakage was likely. In the case of an electric railway near the bridge, the place for insulation would be where the rails were. The old Board of Trade requirements should be regarded as a minimum, and one ought not to go too near to them.

The Imperial Institute.—The functions of the Imperial Institute, South Kensington, erected as a memorial of the Jubilee of Queen Victoria, 1887, will be considerably altered as the outcome of the recommendations of the committee of inquiry and the resolutions of the Imperial Economic Conference. According to the *Daily Mail*, the committee recommended:

"That the Institute should discontinue the attempt to illustrate, by means of Exhibition Galleries, the natural resources of the Empire, and that a representative selection of Empire products be made for a travelling exhibition of a purely educational character, and that the possibility of organising a travelling exhibition of the staple products of the Colonies in appropriate trade centres should be considered.

"The Imperial Institute should continue as a clearing house of intelligence and information."

Sir E. H. Walton, High Commissioner for South Africa, in a minority report, states that the time has passed when the Institute can claim to justify its existence and cost of maintenance.

The Imperial Economic Conference adopted the committee's scheme for the future of the Institute and the Imperial Resources Bureau, subject to the modification that there should be a Laboratory Committee to make preliminary investigations of raw materials to ascertain their possible commercial value.

It was decided that the Dominion and Indian representatives should advise their Legislatures to contribute towards the maintenance of the reconstituted Institute.

Turbo-Condensing Locomotive in Sweden.—The turbo-condensing locomotive, invented by M. Ljungström, is now running on regular express traffic between Stockholm and Hallsberg. All trials confirm the fuel-saving qualities of the locomotive, the consumption of fuel being from 50 to 60 per cent. lower than that of an ordinary locomotive. The air heater constructed by the same inventor has recently been installed on the Brodin steamer *Bur*, and at a large power station in Brussels.—*Reuter's Trade Service* (Stockholm).

A HIGH-PRESSURE D.C. GENERATOR.

An American 15-kW, 12,000-volt Machine.

The production of a very-high-voltage d.c. generator has been a problem of long standing. The Thury system consists of several series machines, each of a moderate voltage; the Thomson-Houston and Brush arc machines cannot be considered since they produce a pulsating current. Moreover, commutating poles alone do not offer a perfect solution of the difficulty because there exist in machines provided with them troublesome flux distortions.

Latterly, a demand has arisen for a d.c. generator of high and steady voltage for radio work, and Mr. S. R. Bergman (consulting engineer, American General Electric Co.) describes in the October issue of the A.I.E.E. *Journal* such a machine that is suitable for a pressure range of from 12,000 to 20,000 volts. It has given excellent results both from operating and economical standpoints, and is believed to possess novel features.

The generator has a distributed winding consisting of two parts, one of which is called the compensating winding and opposes the armature reaction at every point around the circumference so as to effectively prevent any distortion of the flux; a second winding supplies the excitation, and is also distributed.

In order to avoid pulsations in the current wave such a machine must commutate perfectly, and it must withstand short circuits without flashing, which would be dangerous at high voltage. The mechanical limitation of the number of segments in the commutator is a difficulty, and in order to limit the voltage between bars two armature windings are employed, each connected to a commutator at either end of the armature; in a 15-kW generator by employing the largest number of segments that were practical per commutator, the average voltage per bar became about 90, or nearly four times the conventional value.

A two-pole machine is represented by fig. 1, the inner circle being the conductors of the armature winding, the middle circle representing the conductors of the compensating winding, and the outer circle those of the exciting winding. The current distribution in the conductors is indicated by the usual crosses and dots and the direction of the armature reaction is obviously indicated by the line A B. The compensating winding is so arranged that the current in each conductor is flowing in the opposite direction to the current in the opposite conductor in the armature. The compensating winding accordingly produces a resultant magnetomotive force in the direction B A, opposite to the armature reaction. The exciting winding should be so arranged that its magnetic polarisation is along the line E E, *i.e.*, displaced 90 electrical degrees in space from the line A B.

Fig. 1 indicates a full-pitch armature winding. The compensating and the exciting windings would also be laid out as full-pitch windings in which case the end connections would be represented by the dotted line in fig. 1; in such a case the compensating winding would be a counterpart of the armature winding mechanically as well as electrically. Mr. Bergman has, however, found that exactly the same distribution of field winding can be obtained by the use of a 50 per cent. pitch winding, a single coil being indicated by the full drawn line in fig. 1. In fig. 2 (which represents a field winding for a 12,000-V, d.c. generator) all the coils are shown, and in each slot there is a compensating as well as an exciting coil; all the coils together form a mechanically single winding similar to the lap windings often used in the field of induction motors.

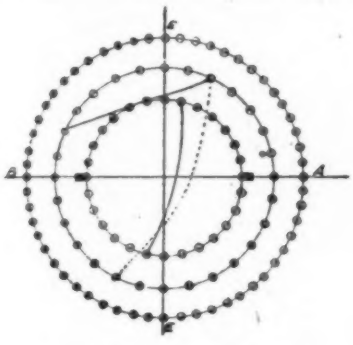


Fig. 1.—Two-pole Machine Winding.

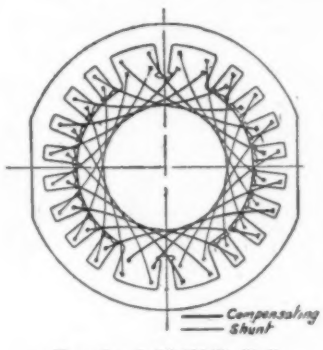


Fig. 2.—A 12,000-V, D.C. Generator Field Winding.

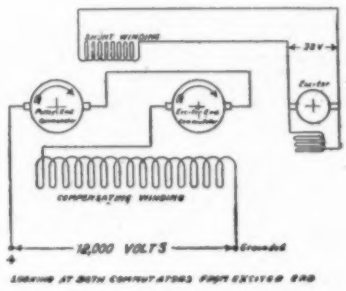


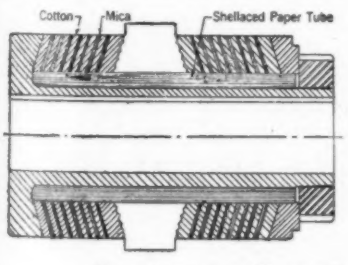
Fig. 3.—Diagram of Connections.

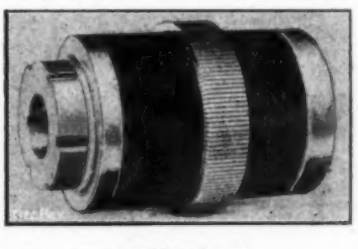
The armature reaction of a full-pitch armature winding is neutralised by a completely distributed winding of a half pitch, by the use of which large economy results, because both windings exert the same magnetomotive force by the use of the same number of turns, but the length of the latter for the half-pitch winding is far shorter. Fig. 2 shows that the teeth of the field are evenly distributed, except that one tooth on each side of the commutating tooth is left out, thereby creating a wide neutral zone. Two commutating teeth are provided and the compensating winding is made slightly stronger than the armature reaction, the difference in the ampere-turns setting up a commutating flux through the commutating teeth.

The fully distributed winding has the advantage of producing a nearly sine-wave flux distribution, resulting in a gradual building up of the voltage gradient on the commutator. After the coils have been assembled in the open slots, steel wedges are inserted to close the openings, except in the wide slots on each side of the commutating pole, so as to prevent the commutating flux leaking sideways.

As has been stated above, the armature carries two independent windings, each connected to a commutator. As the bottom winding has more self-induction than the top one, it reverses more slowly, but this difficulty is overcome by the use of one-third thicker brushes for the bottom winding than for the top.

Fig. 3 shows a diagram of connections of the machine which has a separate exciter because (i) it would be difficult to wind and insulate a shunt field for 6,000 volts, which is the voltage on one commutator, and (ii) at a sudden variation of the load the tremendous induction of the shunt field would cause a discharge through the armature that would set up disturbances and possibly cause the machine to flash over. Five times the normal load can be thrown on and off the generator





Figs. 4 and 5.—"Fabroil" Commutators for 12,000 V (left) and 10,000 V (right).

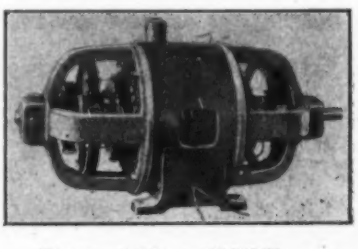


Fig. 6.—A 15-kw, 12,000-V, d.c. Generator.

without causing any sparking or the slightest amount of flashing; the excitation can be thrown on and off without the insertion of resistance in the exciting windings; and repeated instantaneous short circuits through the tubes do not disturbe the machine in the least.

Difficulty was at first experienced in clamping the commutator bars in place by means of mica cones, as they would not withstand the required testing pressure of 40,000 volts. This was finally overcome by the use of the new method of construction shown in figs. 4 and 5, the idea of which originated from the General Electric Co.'s "fabroil gear." The commutator segments are held together under pressure between washers of cotton belting, between which mica washers are interspersed in order to obtain high dielectric strength. The pressure is about 5 tons per sq. in., amounting to a total pressure on the particular commutator under consideration of 120 tons. As cotton possesses the characteristic of resiliency under heavy pressure, the pressure is maintained at all times and the commutator, therefore, is tight under all conditions. Therefore, there need be no provision made for tightening the commutator after it is once completed. This construction gives additional advantages:—

(i) A large and clean creeping distance to ground; (ii) the multiplicity of mica washers provides excellent insulation since they are placed in series with the voltage, a factor which is not obtainable with the methods of construction heretofore employed. An assembled 15-kW, 12,000-volt, 1,750-r.p.m. machine is shown in fig. 6.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Scottish Centre: Chairman's Address.

Mr. R. B. Mitchell, chairman of the above Centre of the Institution, delivered his inaugural address at Glasgow on November 13th. An abstract of the address follows:—

It is, I think, realised by only a few that we, in this country, lag considerably behind America in so far as the uses of electricity are concerned. In Chicago, for instance, a state of development up to 700 kWh per head of the population has been reached. We, in Glasgow, have only attained to 130 kWh per head, and there are very few undertakings in the country which have gone beyond this figure.

If the experience in Glasgow reflects that of other undertakings, then those engaged in the business of electricity supply will require to set their houses in order, so that when the flowing tide sets in it may be adequately coped with.

The concentration of power generation in large stations will make not initial cost, but economy of operation—consistent with reliability—the first essential.

In the boiler house the trend is towards larger units, and it looks as if we may arrive some day at the stage when one boiler only is installed per turbine. My own view is that until load factors are very much higher than they are at present, it is better to carry on with moderate sized units. Again, we hear of a steam pressure of 3,200 lb. sq. in. being mentioned. This development, if put into use, does not appear to make for the ease of mind of central station engineers. Turbine designers anticipate no particular difficulty in designing machines for 1,200/1,500 lb. per sq. in.; for such high-pressure machines undoubtedly two cylinders will be used. With the increase in steam pressure and temperature it becomes essential to use pure water for boiler make-up purposes, and present practice tends strongly towards the provision of evaporators.

Boiler makers anticipate no difficulty in providing boilers for high pressures, but the valves and boiler mountings generally present a real difficulty, and much development is required if these appliances are to be brought into line with other parts of the plant. We may look forward to the operation of all large valves by hydraulic or electrical means.

A single travelling grate stoker, 24 ft. wide by 18 ft. 3 in. long, has been supplied for a boiler in the Calumet station of the Commonwealth Edison Co., Chicago, and it is stated that an overall efficiency for the boiler unit of 81 per cent. has been obtained over long periods.

The firing of boilers in power stations by low grade gas produced as a by-product from coke ovens, or smokeless fuel processes, is only limited by the supply of gas available. There is great need of smokeless fuel in large cities, which would help to solve the ever present smoke problem. Glasgow is taking the lead, and a Committee of the Corporation is at present going into the question of ways and means. The Electricity Committee has co-operated in agreeing to take such gas as is available from the process for boiler firing at a price equivalent to the cost if ordinary coal were used direct.

A supply of gas sufficient for the requirements of a large station can hardly be expected when it is realised that the heat value of the gas is only one-fourth that of the coal from which it is produced, apart altogether from the reliability of the supply. On a limited scale, however, the system is quite feasible.

The cost of installation of coal pulverising plant is just about equal to that of chain grate stokers, but the cost of operation is necessarily greater. The question then is: Does the improved efficiency of combustion—the possibility of using lower grade and cheaper fuel, the flexibility of operation (which is undoubted)—more than make up for the increased cost of operation and maintenance? It must not be forgotten that up-to-date stokers with well designed combustion chambers will burn efficiently the lowest grades of fuel.

Before long thermal efficiencies of 25 per cent. will be obtained by the use of higher pressures and temperatures, preheating and bleeder feed heating, and a close study of heat balance. Such a thermal efficiency, representing 13,500 B.th.u. per kWh, is predicted for the Weymouth station of the Edison Electric Co., of Boston, U.S.A., where the coal consumption will be less than 1 lb. per kWh since the calorific value of the fuel used is 14,400 B.th.u. per lb. However, thermal efficiency is not everything; it is the total cost of the kWh delivered at consumers' terminals which is the real criterion, and the day may come when reliability, capital charges, operating and maintenance will be taken into account in the Commissioners' reports, and their usefulness thereby very much increased.

It seems likely that air heaters, along with economisers (to ensure that stack temperatures will not be much above 300 deg. F.) will come into general use.

Discussion has of late years centred round the question of the best means of driving turbine auxiliaries with a view to efficiency. Turbine designers maintain usually that the house turbine method is the more efficient one, but tests at Dalmarnock do not bear out this contention. One turbine and three boilers were isolated from the remainder of the station and operated, first, with the auxiliaries driven from a unit transformer connected directly to the alternator, the air pump being of the steam ejector type exhausting into a feed heater and, secondly, with the auxiliaries driven from a small house turbine exhausting into a feed heater, the air pump being of the Le Blanc type. In the first case an electrically-driven feed pump was used, while in the second a steam-driven pump was in operation for the boiler feed. The overall efficiencies obtained are practically identical in both cases, so that in this respect the use of the unit transformer scheme is thoroughly justified. The separate drive for the auxiliaries has, however, a great advantage during fault conditions, or when the station is suddenly overloaded, as in these cases the speed of the auxiliary motors can readily be maintained, whereas with the unit transformer system the speed must fall with the drop in frequency of the main machines.

The improvement of load factor is all important, and engineers must not be content simply to wait for better times, but must stimulate consumption during the hours of light load. In dwelling houses this might be done by heating water during the night for use the next day, and in business premises by heat storage at night in suitable appliances, also for use during the next day. Special low rates would be given for these supplies during restricted hours, and the only difficulty to be surmounted would be ensuring that the electricity would be used only within the restricted period. A great deal of business will be done in future on these lines. Not only cooking and heating, but water heating in bulk as well can be catered for and I maintain that a very low rate can be quoted for this business and a profit obtained.

It is apparent that there is to be a general adoption of the two-part tariff. Consumers naturally think in terms of the running charge, and the lower this is the more inclined they are to use electricity freely. It is only right that the two-part tariff should be offered as an alternative to another tariff which should suit the small or the moderate user. The small user should be assessed at a certain number of kWh—equivalent to his lighting consumption—at the ordinary rates for lighting and all energy over this quantity at a much lower rate. For both of these tariffs one meter only is necessary. It is time that the duplication of meters in private houses, and in many other premises as well, was abolished.

My own experience shows that there is a great and ever increasing demand for electric cooking and heating appliances on hire; even in the case of fires, which can be purchased for very moderate sums, people for the most part prefer to hire. Probably the explanation is that if the hire charge includes the installation of the wiring and also the maintenance of the heating elements—as it ought to do—the consumer is relieved of a deal of worry and possible expense.

In Glasgow recently, within a fortnight, at a demonstration of electrical cooking and heating appliances held in one of the new housing areas, 166 fires and 38 cookers were hired to residents in that area. This was accomplished by means of a circular letter addressed to each house, inviting the people to come and see the demonstration. Later on at a Housing and Health Exhibition, orders for the hire of 258 fires and 52 cookers were received within three weeks. These results show what can be done by means of a little publicity.

In some large towns it may be necessary to go further than the hiring of appliances. In Glasgow, for instance, there are 250,000 dwelling houses; of this number only 14,000 have electric lighting installed, and tenants object as a rule to spend money on the improvement of property not their own; it seems to me that the only hopeful means of taking in this class of property is for the supply undertaking to inaugurate a scheme of wiring on hire or hire-purchase terms. In municipal undertakings, particularly, this suggestion might well be adopted by the Corporation and, provided that the terms are sound economic ones, very little risk would be incurred. The proportion of this load which comes on at peak time may be put at from five to ten per cent. of the connected load.

In addition, the diversity of use is very high and connections may be made freely, within limits, without fear of overloading distributors. It may be argued that in suburban districts the houses are sometimes widely apart and only a small return is to be expected per yard of distributor laid. While this may have been so when lighting only had to be considered, nowadays the situation has completely changed, due entirely to the possible other uses of electricity in the home. From a scrutiny of actual accounts, it is clear that the "other uses" of electricity in dwelling houses increase the consumption, in the majority of cases, from eight to thirty times and the revenue from five to six times that for lighting only.

The value of electric battery vehicles to power supply authorities is not fully appreciated. At least 15,000 road battery vehicles are in operation in the United States, and the electric battery vehicle is relatively much more expensive in America than in this country. It has made progress in America against even stronger opposition than it encounters here, and the cost of petrol is much lower in America than in this country, while the cost of electricity is approximately the same. But it seems to me that it really lies with the battery makers to decide whether or not the electric vehicle will make real progress here.

Welfare in industry is a subject which closely affects electricity undertakings and will, I hope, have an immense and lasting influence. I speak with experience of some four years' operation of a Whitley scheme, allied with welfare, in the Glasgow electricity department, the former dealing with domestic matters and the latter with matters affecting the employés outside working hours. This scheme has been an unqualified success, the men are fully alive to the benefits which have been derived, and I am convinced that the work of the department is being better done by a more contented body of men.

All matters which cannot be settled by a sub-committee are brought to a higher committee, and it is evidence of the good feeling prevailing when it can be said that the central committee has not required to sit for over eight months. For the success of a scheme of this kind, much depends on the tact and discretion of the welfare supervisor. We are, or should be, all interested in the humanising of industry, and why not in electricity supply as in anything else? I recommend strongly, from my own experience, the establishment of such schemes in all great industries throughout the country. Electricity supply is now vital to the prosperity of the country and I am convinced that the proper carrying on of such schemes will go far to eliminate one of the factors which, during the past few years, has endangered to a serious extent its continuity.

THE CARDIFF MINING ENGINEERING EXHIBITION.

General keen interest was taken in the mining engineering exhibition that was held at Cardiff (November 29th to December 8th), under the auspices of the South Wales Institute of Engineers. It will be recalled that the first venture of the kind was in 1921, was confined to fuel-saving appliances, and was held at the Institute. A year ago the Council of the Institute was more ambitious, and a general exhibition was held at the Drill Hall, and so successful was it that the premises proved to be quite inadequate. Encouraged by the success of its enterprise, the Council repeated the experiment this year, but notwithstanding the fact that the show was limited to a display of machinery and appliances applicable to the South Wales coal mining industry, the Hall did not provide anything like the accommodation that could have been filled, and when officially opening the exhibition the Lord Mayor (Alderman Sydney Jenkins) expressed regret that the city had no more commodious premises available. Prior to the inauguration of the show at a general meeting of members of the Institute, the Lord Mayor extended a civic welcome to the exhibitors who numbered 87, amongst whom the following firms showed apparatus of electrical interest:

The British Mannesmann Tube Co., Ltd., in addition to other things, had on view one-piece tubular poles for electric light, traction, and power transmission purposes, the attention of visitors being also specially drawn to two electric light standards at the entrance to the exhibition.

Messrs. Thomas Broadbent & Sons, Ltd.—Squirrel cage motors and centrifugal clutches.

Brookhirst Switchgear, Ltd.—Switchgear for both hand and automatic operation, of the d.c. and a.c. types.

The Cambridge & Paul Instrument Co., Ltd.—Electrical indicating, recording, and measuring instruments.

Messrs. Campbell & Isherwood, Ltd.—Portable electric drilling machines and hand drills, a magnetic drill stand, a.c. and d.c. motors, and the Gush electrolytic system of protection for boilers, condensers, &c.

The "Ceag" Miners' Supply Co., Ltd.—A range of electric safety lamps for use underground in mines; also charging stands, hanging racks, &c., shown in operation to illustrate the complete installation of a lamp cabin.

Mr. George Ellison.—Low pressure a.c. and d.c. starting and control gear.

The English Electric Co., Ltd.—A 200-kVA transformer, switchgear, d.c. and a.c. motors.

The Federation Lamp Co.—All-metal dry battery electric mine lamps, a new type of charging stand, combination electromagnetic unlocking and lamp-opening machine, translucent lamp glass, portable voltmeters, and a low-voltage and reverse-current protective system for battery-charging circuits.

The General Electric Co., Ltd.—Model of a geared winding engine, last wheel of a 12,000-kW, 3,000-r.p.m. turbine, Witton Kramer hoisting block, lifting magnet, and portable tools, motors, switchgear, miners' lamps and charging stands, signalling gear and relays, Osram lamps and thermionic valves, and a petrol-paraffin electric lighting set.

Messrs. Gent & Co., Ltd.—Flame-proof signalling bells, telephones, keys, electric motor sirens, radio and other electrical apparatus for collieries.

Messrs. Haslam & Stretton, Ltd.—Amongst other gear showed Reyrolle switchgear, electrical exploders, testing and measuring instruments and the "Fellophone" 2-valve radio receiving set.

The Igranic Electric Co., Ltd.—Switch and control equipment, starters, magnetic separators, clutches, and brakes, Dean valve control gear, and battery-charging panels.

Messrs. Mavor & Coulson, Ltd., in addition to switchgear also exhibited a "Universal" chain coal cutter having a 4-ft. jib and driven by a 3-phase motor; it is arranged to cut at the floor level, and can be converted into a bar cutter.

The Metropolitan-Vickers Electrical Co., Ltd.—D.c. and a.c. motors and switchgear, including a new form of liquid controller with a starter switch and operating gear.

The New Switchgear Construction Co., Ltd., and the Cartret Switchgear Co., Ltd.—Cubicle switchgear, oil-immersed switch-fuses, switchboards, breakers, isolating switches, &c.

Robins Electrical & Wireless Depot & Institute, Ltd.—Radio and electrical appliances.

Messrs. A. E. Smithson & Co., exhibited, as agents for the makers, a 25-kW generating set and switchboard, by Messrs. Troup, Curtis & Co., Ltd., and a pump, grinders, polishers, planers, &c., driven by 1.1-h.p. motors, by Messrs. Rene Volet, of Paris.

The Sterling Telephone & Electric Co., Ltd.—Telephones, blasting machines, bells, relays, batteries, indicators, radio receivers, loud-speakers, and a mine shaft signalling system.

Messrs. E. Thomas & Williams.—Miners' flame and electric lamps, shot-firing magnetos, unlocking magnets and accessories for lamp-room use.

The Thor Electric Safety Lamp Co., Ltd.—Lamps, charging equipment, and accessories for the lamp room; also a photometer was shown suitable for testing lamp bulbs, and "Droptric" glass which is claimed to increase the candle-power of lamps and be of assistance in nystagmus cases.

Messrs. J. Samuel White & Co., Ltd.—An electrically-driven immersible pump (Reed Cooper patent).

The Wolf Safety Lamp Co. (William Maurice), Ltd., showed amongst other types of lamp, nickel-cadmium electric lamps of various patterns.

Messrs. McWhirter & Sons, Ltd., electrical repair specialists and suppliers, also exhibited.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Shadowless Lighting System.

In a catalogue of "Brascolite" fittings, recently published by the Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C.2, a shadowless lighting fitting appears. This, the "Barlett Noshadowlite," is illustrated in fig. 1. As will be seen the fitting consists of a ring of eight parabolic reflectors suspended from a ceiling plate in which are fixed eight small lamps for the general illumination of the room. The appliance is especially suitable for use in an operating theatre, for each parabolic reflector is focused upon a central point and fixed in that position. A ball-and-socket fitting in the centre of the ring provides a convenient means of moving the lights to any side to follow movements of the operating table. The reflectors have polished aluminium interiors, and are fitted with 2-in. diameter frosted ball lamps, which are concealed from the view of the operator.

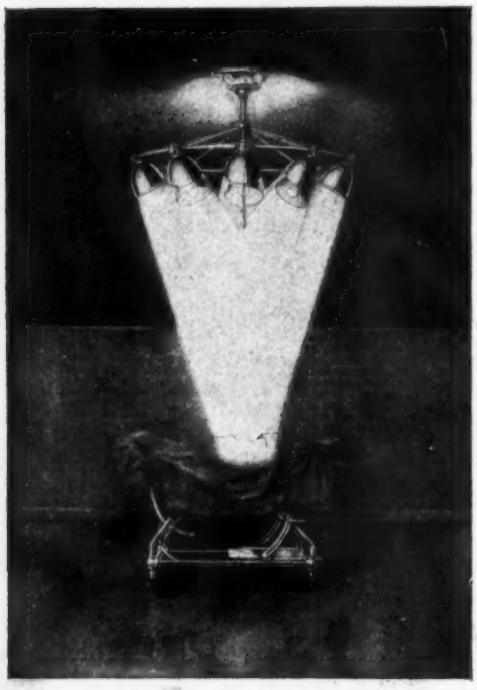


Fig. 1.—The "Barlett Noshadowlite" Fitting.

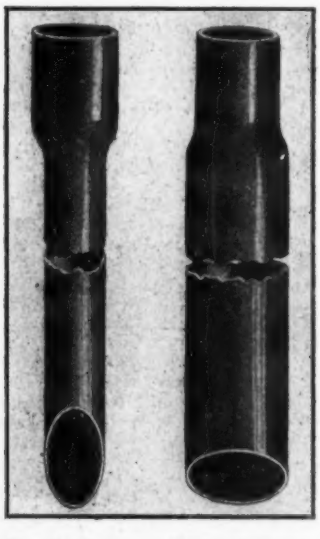


Fig. 2.—Round to Oval Conduit.

Oval Conduit.

The Middlesbrough Steel Tube & Conduit Co., Ltd., Lower Commercial Street, Middlesbrough, has issued a leaflet drawing attention to a new form of conduit for which the company has taken out a provisional patent. This is round conduit drawn into oval section throughout part of its length. Where the plaster is thin and the brickwork uneven, as is frequently the case, round conduit will project above the plaster unless the brickwork is channelled, which increases labour costs. With oval conduit this difficulty can be avoided in many cases. The ½-in. conduit is drawn to an ellipse measuring ½ in., and ¾ in. on its axes. The tubing is produced in 6 ft. 6 in. lengths as a standard.

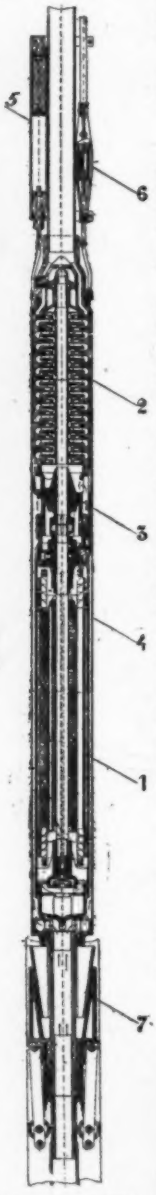
The accompanying illustration (fig. 2) shows that the oval portion of the conduit can be smaller or larger than the original tubing.

New Type of Water-tight Motor.

A German firm has recently brought out a new type of motor for use in narrow spaces, such as bore-holes, oil-wells, &c., which has some novel features. The Reda, as it is known, is air- and water-tight, and is a 3-phase, high-speed motor, constructed with a vertical shaft and direct coupled to a pump, the whole unit being enclosed. Fig. 3 is a drawing of the set as described in the *E.T.Z.*

Owing to the amount of heating caused by reason of the small diameter of the motor, a special system of oil-cooling effected by a force pump fitted to the end of the shaft is provided. The oil in circulation also automatically lubricates the parts of the motor and pump in contact, and any impurities are deposited in a special trap and do not get back into circulation. The motor is constructed in all the usual voltages, and even up to 1,000 to 2,000 V, where necessary. When the horse power of the motor is above 5 h.p., the rotor (which is short-circuited, as standard) is fitted with a special starting device, which eliminates slip-rings, brushes, brush-lifters, series resistances, &c., which would otherwise be necessary. This starting device, which is patented, is also applicable to open-type motors. The starting current remains within the desirable and permissible limits. No special conductors are necessary from the motor slip-rings to the series resistances, nor does the rotor burn out when overloaded—a great advantage and saving.

The manufacturers of the Reda motor have recently supplied a motor-pump set of 40 h.p. This is said to run extremely well under water, at 1,000 V, and 26 cycles per sec. The oil-cooling arrangement of the motor is so efficient that the motor can run satisfactorily even in hot liquids. The current is supplied to the motor (which is housed below the pump) by a protected cable carried along the pressure pipe and terminating in a special cable socket immediately above the pump. The motor is fitted with a patent self-tightening gland working on the hydraulic principle.



1, motor; 2, centrifugal pump; 3, gland; 4, external casing; 5, lubricating chamber; 6, cable thimble; 7, safety catch device.

Fig. 3.—A New Water-tight Motor.

Novel Electric Truck Battery Suspension.

In a recent issue of the *Scientific American*, a novel form of battery suspension in an electric truck was described. The chassis of the truck is illustrated in fig. 4.

The driving motor is mounted under the seat. It is hung in a heavy cross member, which also serves as a support for the front end of the battery. The motor is connected to the rear axle through a three-joint propeller shaft.

The battery trays are mounted in a single master tray, which is on rollers in the cradle, and can be moved, without auxiliary apparatus, into a position where all of the cells of the battery can be reached for attention.

It is unnecessary to break any electrical connections to do this work, and the door of the battery box serves as a lock for the sliding tray. Means are provided for stopping the tray at the end of its travel, but these stops are easily de-

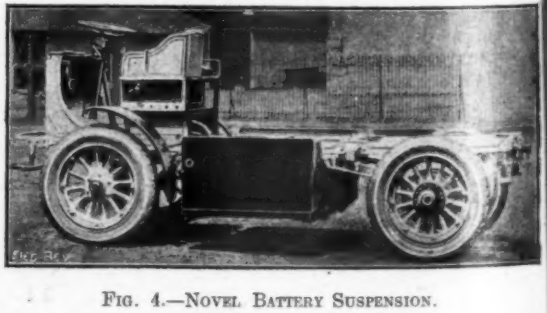


Fig. 4.—Novel Battery Suspension.

tached when it is necessary to remove the entire tray from the truck. Therefore, for replacement purposes, the battery can be removed easily in two sections and a fresh battery substituted. The trays and compartments will accommodate regular and oversize batteries for the various models. Any standard battery can be installed.

In the new truck the problem of concentrated weight is relieved by swinging the battery cradle in links to permit movement in the direction of the motion of the car, and with this movement opposed by springs, quite distinct from the chassis springs, a construction is obtained which eliminates shocks due to this suspended weight.

The chassis is designed as a complete unit, with no part of it depending on the body. Two brakes are provided, the ordinary service foot-brake, and a hand brake for emergencies and for holding the truck when at rest. It is also possible to reverse the motor for emergency braking—a feature unique to the electric truck.

Inductance Wire.

Messrs. Leslie Dixon & Co., 9, Colonial Avenue, Minories, E.1, are manufacturing a special kind of wire intended primarily for inductance coils. This is of 22 gauge, high-conductivity copper, enamelled, and covered with a single wrapping of cotton. It is claimed to be more durable, and to possess better insulation than d.c. wire and it does not require to be coated with shellac.

CORRESPONDENCE.

Letters received by us **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Delayed Deliveries.

Your correspondent "Hadsum" has raised a matter which is more than serious. The question to-day is to get to know a firm which values its reputation, and to which orders can be given which will be properly executed and delivered in the time stated on the quotation. In pre-war days an order could be placed with the sure knowledge that what was ordered would be obtained at a reasonable price and in reasonable time. To-day, I know of no such firm. The last few years it has been easier to keep a "good" list than a black one. Orders to-day are obtained on false representation. Instances of such could be given by the dozen, and the trouble applies equally to large and small firms. It applies to electrical apparatus and goods of all descriptions. In fact, English manufacturers seem to go out of their way by their present-day methods to cause annoyance and trouble, and the only easy way of retaliation is to delay payment of the account, when they will condescend to write to you.

If, sir, the Electrical Review can help to put things a little bit right, it will be a blessing to many situated in a similar position to

Disgusted.

December 4th, 1923.

With regard to the letter of your correspondent "Hadsum," and your comments thereon, I am fully convinced with yourselves that there is a tendency for the commercial and sale side of electrical business to become slipshod. It is true that in large works this to some extent is unavoidable, because the routine is so elaborate and costly that the systems do not have the effect they should do; one has only to look back 20 years to find that in most electrical companies the sales or commercial manager was a well-known individual, a properly trained engineer with selling abilities, whose promises with regard to delivery could be depended upon because his good name was at stake. To-day, a very large number of commercial or sales managers have practically no engineering experience, and are unknown, low-salaried individuals, who do not take the trouble to see that any letter that they put their signature to can be relied upon. Formerly, a sales manager made periodical visits to different towns, and became personally acquainted with the company's customers, but nowadays he sits in an office surrounded with card systems, &c., and the loss of the personal element causes an effect on the business relationship between the company and the customer. I have recently come across several cases where reputable firms have appointed in various towns agents or representatives of poor standing, principally from the cause I have stated above—that the person who is appointing these agents probably has not called on them or their district to feel how they are received in their own districts. Naturally, no great amount of business can be expected from such agents or representatives, and when they are asked to give promises of delivery they very often give false dates without referring to the works. On the other hand, I recently had experience of a firm which on receipt of an order required seventeen documents to be made out for various departments; the dealing with these documents naturally delays putting the work into execution, and when it comes to dispatch, sometimes causes two or three days' delay before the goods can be put on the lorries, the whole thing being system run mad. Whilst it will be argued that cutting down system is detrimental, I am sure that there are better methods of dealing with inquiries, orders, and dispatching than are in operation to-day.

I, personally, know of one company in particular which 14 years ago was practically closed down, but the new sales manager, who was well-known throughout the trade, and could be relied upon for keeping up his reputation for truthfulness and personal attention to customers, has turned this company into a very flourishing concern, without the use of a staff to carry out his duties for him.

Victor.

London, *December 4th*, 1923.

Your correspondent "Hadsum" is to be congratulated for having prominently brought before readers a subject which is a very thorny one for all concerned.

As the head of a big manufacturing department, I beg to enclose copy of a short note—which I wrote in March, 1922—to my company's sales department, for insertion in its monthly journal.

The above-mentioned sales department is manned by a large staff of able and experienced engineers. I am still, however, waiting for a response to the points raised.

Ex Adverso.

December 4th, 1923.

[Copy.]

It seems apparent that in some quarters the idea prevails that when manufacturers are "slack" quick delivery of almost all kinds of cable fittings and accessories must be possible.

Unfortunately, such is not the case, and apparently it never will be, unless there is to occur a transformation which is not conceivable at present.

In the first case, there are some components (very desirable ones for their purpose) which will always take several weeks to make. When, also, as not infrequently happens, some of these turn out unsuitable, there is a further period absorbed in re-making. Many of the above are purchased from outside sources, and the control is primarily in their hands.

The obvious retort to the above is to recommend purchasing well ahead; in other words—for stock. This, however, will not do at all, one reason being that to suit the vagaries of our clients, there is a multitude of articles to be considered. It would be against every commercial instinct to carry such a huge and varied stock, and there are, as well, other obvious reasons why this could not be done.

To cut out the classes of material which take longest to manufacture from our designs, would be to impose limitations which would reflect adversely both in regard to suitability and price.

There are one or two things which agents might particularly devote themselves to. One is to oppose, in so far as it is safe and possible, the introduction of any change or variation from the standard. Another is to stress the desirability of different clients' using the same design of thing for the same purpose, and to order in sufficient time to allow of the goods being economically produced.

Another problem that constantly presents itself is as to the delivery promise which should be given.

"A" is a manufacturer who has a definite output, which cannot be increased above a certain maximum without considerable outlay. His maximum output capacity has been carefully fixed, having strict regard to the average yearly market requirements, both past and future.

"B," "C," and "D" are all potential purchasers of "A's" goods. They each, however, take different designs of goods. Their purchases are intermittent, and they only buy to meet current requirements. For several reasons, it is not feasible for "A" to stock goods for his customers. "A's" particular goods each absorb three weeks to make, from start to finish, and "B," "C," and "D" together take his entire maximum output. They should, therefore, to balance things, exactly, each be supplied at intervals of nine weeks. But one day, when "A" has just finished up all his orders, he receives an inquiry, for his usual quantities, from all three customers. An important clause in each inquiry is the time required for delivery. Three weeks would get him the orders. There will be no more inquiries for nine weeks. "B," "C," and "D" each, all, or none, may order. Or, they may split their orders.

What time is "A" to quote in each case for delivery?

I have read with considerable interest the letter of your correspondent "Hadsum," regarding the very thorny problem of delivery, and having had some 16 years' experience with a firm manufacturing some thousands of patterns of fittings, many consisting of a considerable number of parts, and being accustomed to receiving 200 to 300 orders per week, 80 per cent. to 90 per cent. of which have to be more or less manufactured, I would venture to point out some of the difficulties manufacturers have to contend with.

It has to be remembered that we have constantly in front of us lists of hundreds of promises all maturing within a period

of say six weeks, and as very often happens out of a full week's orders, no two call for similar articles. The following week may produce in the space of two days six or seven inquiries for quantities of a certain fitting. Our output is of course known, but we do not know if one or all of the inquiries will mature into orders, or when they will mature: Perhaps the next day, possibly not for two or three weeks. We have also to remember that other manufacturers are also quoting and will give as close a date as possible, and we can, therefore, only assume that we may receive one or two orders. However, our price happens to be favourable and we receive them all, and are immediately faced with the problem of having promised more than our output. We cannot very well write to all these clients to explain that the delivery quoted three or four days ago cannot be kept, and we do not know if they are all urgently in need of the articles. We only hope they are not, but at all events some of the promises given have to be broken. It follows that we may have a considerable number of machines standing idle and still break promises, as our output of a particular article may depend on the fact that we have only one moulding pattern which is normally sufficient for our needs.

"Hadsum" refers particularly to standard catalogue stuff, and he may be interested to know that we have in our catalogues quite a number of patterns that we have never been called upon to supply (although any client would be quite justified in referring to them as standard catalogue stuff), and there are many others we supply perhaps once per annum.

I must apologise for this lengthy letter and, passing over mishaps in manufacture, broken tools, and other shop causes of delays which are of daily occurrence in any large works, close by merely referring to the large number of customers who like our sample and give us orders on condition that we alter it slightly to meet their own fads or fancies, thus still further increasing our enormous quantity of patterns and preventing us from carrying anything like the quantity of standard articles in stock that we should like to. Only those who have experienced it know the trouble these special fittings cause in manufacture along with standard lines, but our clients are valuable and our mission in life is to do our best to please them.

Very Sorry.

December 4th, 1923.

A Non-Technical Explanation of "Power Factor."

In reply to "Cui Bono?" I may as well explain that my appeal for an explanation of power factor which would satisfy the average non-technical user, originated during an interview with a well-known central-station engineer of considerable attainments, who drew attention to the difficulty he had experienced in explaining power factor to his consumers, and to the desirability of evolving a suitable explanation. We were both agreed as to the need and the difficulty, and it occurred to me that the subject was of sufficient importance and interest to warrant an appeal to the profession as a whole for a solution.

As to whether it is possible to evolve a satisfactory explanation in strictly non-technical language I cannot say, but the adjudicator will doubtless deal with this point in a common-sense manner and award the prizes in the order of the effectiveness of the solutions.

Whoever the adjudicator may happen to be, he will have no difficulty in testing the effectiveness of the solutions by trying them on actual non-technical consumers.

If the gentleman I am proposing to ask to undertake the task of adjudicating is willing I have no doubt his decision will be accepted as impartial and authoritative.

In reply to "Cos ϕ," the results of the competition will of course, be published, together with the successful solutions, provided that the Editor is satisfied they are worthy of publication and is willing to afford the necessary space.

I might, perhaps, add that while a number of ingenious explanations have already been received, the competition remains open until December 31st, and it is hoped that no one who can think of a really simple solution will fail to send it in.

R. Amberton.
Director, Electrical Apparatus Co., Ltd.

London, *December 10th*, 1923.

I am of opinion that the competition promoted by Messrs. The Electrical Apparatus Co., Ltd., for the best non-technical explanation of power factor is likely to do a lot of good.

It is an exceedingly difficult matter to explain power factor to the layman, and it must follow that some of those who will enter for the competition will express views which are sure to be of help to those who, like myself, are so frequently called upon to give this explanation, and I endorse "Cos ϕ's" suggestion that the successes should be published in your journal.

Too great importance should not be attached to the *necessity* for explaining power factor.

If a consumer's rates incorporate a fixed charge per kVA of maximum demand, it is quite as reasonable to suppose that he will not ask for an explanation of kVA involving power factor, as that he should ask for an explanation of the operation of a unit meter which likewise involves power factor.

How often does it occur that a consumer of alternating current asks for an explanation as to the difference between apparent power as indicated by the ammeter and voltmeter on the one hand, and actual energy as indicated by the unit meter?

The fact is that the consumer has sufficient faith in the power supply undertakings to accept the unit meter as being accurately compensated for power factor.

E. W. Dorey.

London, *December 11th*, 1923.

In your issue of November 30th, you published a letter from Mr. R. Amberton, in which he offers prizes for an explanation of power factor which would be satisfactory to a non-technical user of electrical energy. I think that as long as the consumer has to pay a penalty for bad power factor, an explanation which will satisfy him will be very hard to find. I suggest as a solution of Mr. Amberton's problem, which is, however, *hors concours* for the prize, that tariffs should be so adjusted that the normal rate is based on a low power factor and the consumer receives a bonus if he can improve it. If the consumer is to pay a penalty under a power factor clause, he will find the subject very intricate. If he can obtain a bonus under such a clause, human nature being what it is, he will be able to understand power factor quite easily.

Reginald O. Kapp.

Westminster, *December 7th*, 1923.

Local Exhibitions—Glasgow.

Despite Mr. Hardie's denial, in this week's issue, of my statement of the procedure of the sales and showroom department of the Glasgow Corporation, in my particular case, the order was secured as stated. Also, I have been told by other contractors of similar **treatment in their case.**

Re Mr. Hardie's remark that contractors have a free hand, we have, but none of us has a showroom fitted up, stocked, and staffed at the expense of the ratepayer.

Another thing, in these hard times (for contractors anyway) we are lucky to secure the order for an installation with a promise to consider radiators, &c., when installation is completed. Many customers will tell one that they will consider these items later.

Again, if, as Mr. Hardie states, the showroom staff has difficulty in keeping up with orders, this could be the time to stop circularising the just-joined up consumer, and give the contractor who pays rent and taxes for his showrooms a chance to make a little.

Re the remark about anonymous correspondents, one would think it was not a usual practice to write to the Press without signing one's full name and address. You know we cannot all afford to be, if such a thing were possible, unpopular with Corporation officials.

But, in any case, I, before writing my letter, did call and present my business card both at the head office and the showroom, and was informed that the showroom did send out the circulars and invitations, and this was, as before stated, prior to the supply being connected up; and the said invitation had been in my customer's office for days.

In any case, if my letter helps the contractor to get, shall we say, a longer chance to sell radiators, &c., I have done a little good.

A Contractor.

December 7th, 1923.

Referring to the recent correspondence which appeared in your columns *re* the above, on behalf of the Electrical Contractors' Association of Scotland, allow me to point out for the benefit of the electrical trade generally, that in Glasgow the Association is always ready and willing to deal with the matters therein referred to. This being so, if any of your correspondents (whether members of the Association or not) have any grievances against the Glasgow Corporation, with respect to the operation of the showroom, if they will kindly communicate their grievances to me, specifying the nature thereof, they may find it beneficial not only to themselves, but to the trade in general.

I may say that the Association has always been in close touch with the Corporation in respect of questions relating to contract work, &c., and its invariable experience has been that the city electrical engineer and manager has ever been ready to give careful consideration to all matters brought under his observation.

P. Armour,
Secretary, Electrical Contractors' Association of Scotland (Glasgow Branch).

Glasgow, *December 8th*, 1923.

Petrol-electric (battery) Propulsion.

I was very interested to read the article on "The Misuse of the Internal-combustion Engine," by Mr. L. Murphy. I thought it might interest you to know that I constructed a 3-ton lorry, exactly on the lines suggested by Mr. Murphy, about three years ago, and it is still in service and doing extremely well.

Of course, my intention has been to produce this type of vehicle commercially, but for several reasons, one being on account of our wonderful patent laws, this has not materialised yet.

There is no doubt that this principle is the right one to adopt, both for road and railway work.

The 3-ton lorry which I constructed consisted of a 9-b.h.p. petrol or paraffin engine, driving a 5-kW generator. The battery is 80 volts, 130 ampere-hours capacity. The two motors are each 4½ b.h.p. continuously rated, but capable of doing 200 per cent. overload for short periods.

The motors are regenerative, so that advantage is taken when running downhill to charge the battery, instead of wasting energy in the brakes.

The average speed of the lorry is about equal to that of a petrol lorry; the weight is also about the same. The petrol consumption is about 20 miles per gallon.

The engine runs on full throttle, at its maximum output and efficiency, all the time the lorry is in service, which, of course, explains why the mileage is so high. Owing to the fact that the engine is running on an unvarying load, the carburettor can be adjusted exactly right. This, you will agree, is where great losses occur in the ordinary lorry, because the carburettor can only be set to effect a compromise under the varying conditions.

I hope you will be interested in this short description, and I would like it to be put on record that there is in existence a lorry constructed on the lines suggested by Mr. Murphy.

H. Green.

Manchester, *December 8th*, 1923.

Single-core Cables on Three-phase Systems.

In your issue of November 30th, on page 812, there is a letter by Mr. R. O. Kapp, *re* the earthing of cables. If we consider a 3-core armoured cable laid direct in the ground, which means that it will be insulated from earth except at the joint boxes, a good method to adopt would be to deal with the joint boxes as earth plates themselves and surround them with carbon.

Mr. C. P. Sparks ("Electric Switch and Controlling Gear," by C. C. Garrard, page 577) states that an earth plate may give a resistance of two or more ohms to earth; the resistances of lead sheath and armouring for a cable of fairly large section to a fault 1½ miles from the station would be 0.80 ohm and 0.5 ohm respectively. From this it would appear that there is an efficient earth *via* the cable sheath or the armouring. If the joint boxes were treated as suggested, it would mean that for a partial earth the p.d. in the sheath would flow direct to the station earth plate *via* the sheath or armour. As the fault increased, the joint boxes would clear the fault when the resistance of two ohms was overcome, and so prevent the ground around the boxes becoming dangerously charged.

E. Berry Nixon.

Sunderland, *December 4th*, 1923.

Tendering for Electrical Contracts.

I was much interested in the article by Mr. E. A. R. Paton, M.A., on the above subject in your last week's issue, and particularly in his admiration for the way in which contractors for power station equipment prepare their estimates, and the "wonderful accuracy" with which they must know what everything they make in their workshops is costing them, and the close manner in which they are able to tender.

I have lately had tenders from three large firms for certain power station equipment in sums amounting to about £14,000, differing by less than £1.

Costing by such electrical manufacturers is certainly reduced to a fine art, as Mr. Paton remarks. I wonder if these contractors for power station equipment have any further knowledge on this tendering question not particularly referred to by Mr. Paton, which might be of assistance to their brother contractors in a "smaller way of business." Perhaps someone can enlighten us on the matter.

A Constant Reader.

London, *December 10th*, 1923.

The Cost of Living in South Africa.

The course best suited to "Interested" would be, I think, for him first to invest in the following publications if he has not already seen them:—

Official Year Book, 5s.

Quarterly Abstract of Statistics, 1s.

Both are obtainable from the High Commissioner (Publicity Department) for the Union of South Africa, Trafalgar Square, London, W.C.

These will furnish him with authentic information concerning social and other matters. The statistical tables will enable him largely to form his own opinion of the least salary that would induce him to go there.

In the case of a married man, particularly if there is a family, it is difficult to give advice as so much depends upon the circumstances of the case. Without in any way suggesting that South Africa cannot amply recompense one for the severance of the home-ties, I do think that the consensus of opinion would be that if "Interested" is in reasonably comfortable circumstances here there is little to be said in justification of his making a change unless the immediate financial gain is attractive. It is important for him to consider whether he intends to settle there, for, if he adopts the rôle of a "bird of passage," there is a likelihood of his being disappointed with the result. Then there is the question, who will pay the cost of the transfer? If that cost is a debit against "Interested" it will require a still greater financial justification to warrant the move. He should keep well before him the matter of his wife's interests, because it is likely that she will find a greater difficulty in adapting herself to the new circumstances than will "Interested." Boarding-house life, which will very probably be a feature of the change-over, is apt to be very trying to a new-comer, although the "seasoned" ones find it happy enough.

Assuming that "Interested" means to look to South Africa for his future, I should say that a commencing minimum salary of £450 a year for Capetown, or £600 a year for Johannesburg, would be a reasonable proposition. This is intended to cover purely personal requirements. If he is to be a principal, or is to be called upon to represent a principal, the question of an allowance should be considered.

It is often said that the European population of South Africa is a "white aristocracy," and this arises in consequence of the fact that the non-European element (which is very large) performs practically the whole of the "rough" work. It can be said with truth that the social conditions are very good indeed.

Although the general economic conditions are not all that could be desired at the moment, especially as regards the numbers of unemployed, I do not think that one could properly say that the opportunity for success in an individual case is entirely lacking on that account.

If "Interested's" headquarters are to be inland, the matter of altitude should be considered, as Johannesburg, for instance, is 6,000 ft. above sea level, and not everyone finds that comfortable from the physical point of view.

Taxation exists, of course; income tax commences at £300, and is approximately 1s. in the £ for a married man with allowances for children, insurance policies, and so forth. In addition, there is a Provincial Tax, which is really another income tax on a reduced scale, amounting to something less than one half the amount paid as income tax.

It should be carefully noted that this information relates exclusively to the territory known as the Union of South Africa, which embraces the Provinces of the Cape, Natal, Transvaal, and Orange Free State.

Veritas.

December 10th, 1923.

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEPTON-JONES, O'DELL AND STEPHENS, Patent Agents, 285, High Holborn, London, W.C. 1.

The name of the applicant's patent agent, if any, will be found on the printed specification.

29,608. "Closures for electric primers for detonators, &c." Etablissements Davey, Bickford, Smith et Cie., Soc. Anon. Française. November 23rd. (France, January 17th.)

29,611. "Loud-sounding telephone receivers." G. E. A. Pohu. November 23rd.

29,613. "Automatic re-closing circuit-breaker systems." British Thomson-Houston Co., Ltd. November 23rd. (United States, November 23rd, 1923.)

29,623. "Electric transmission systems." A. M. Taylor. November 24th.

29,641. "Anti-dazzle lighting devices for vehicles." E. C. Ashington. November 24th.

29,644. "Telegraphy, telephony, &c." F. S. de Barro. November 24th.

29,660. "Earthing clips for electric conductors." L. H. Reid. November 24th.

29,672. "Balancer for unsymmetrically-loaded alternating-current systems." M. L. Kahn and A. H. Railing. November 24th.

29,677. "Rheostats." Lissen, Ltd., and R. P. Richardson. November 24th.

29,678. "Rotary machines, &c." Metropolitan-Vickers Electrical Co., Ltd. November 24th. (United States, December 6th, 1922.)

29,679. "Electric switch mechanisms." Metropolitan-Vickers Electrical Co., Ltd. November 24th. (United States, December 13th, 1922.)

29,681. "Telephone-call recording meter." V. C. Malden. November 24th.

29,683. "Apparatus for use in oscillatory electric circuits." W. L. Shaw. November 24th.

29,685. "Electric speed-controlling devices." Eastern Telegraph Co., Ltd., and H. V. Higgitt. November 24th.

29,686. "Alternating-current generators." Eastern Telegraph Co., Ltd., and H. V. Higgitt. November 24th.

29,696. "Telegraphy and telephony." A. R. Angus. November 24th.

29,699. "Insulating cap for cable joints or ends." F. M. van Gelderen. November 24th. (Holland, October 8th.)

29,702. "Selective receiving circuits." Siemens & Halske Akt. Ges. November 24th. (Germany, November 25th, 1922.)

29,722. "Wireless communication system." E. V. Appleton. November 26th.

29,728. "Fitting for supporting gas and electric light globes." A. Wilson. November 26th.

29,729. "Self-regulating electric switchboard." S. H. Long and X-Rays, Ltd. November 26th.

29,732. "Electric distribution systems." J. R. Beard and Electrical Improvements, Ltd. November 26th.

29,740. "Electric junction boxes." B. Wilhelm. November 26th.

29,742. "Telephone systems." Coventry Automatic Telephones, Ltd., and C. W. Wilman. November 26th.

29,743. "Transmission of sound in gramophones, wireless apparatus, &c." H. Mandelstam. November 26th.

29,744. "Rheostats and potentiometers." M. M. Houghton. November 26th.

29,767. "Lighting magnets for vehicles." E. Baumgartner. November 26th.

29,771. "Electrolytic variable resistances." S. Gowan, S. C. Lloyd, and Metropolitan-Vickers Electrical Co., Ltd. November 26th.
29,772. "Electric transformers." W. Dornig. November 26th.
29,780. "Multiple telephone connectors." Drake & Gorham, Ltd., and H. Gaskell. November 26th.
29,788. "Combined switch and stand for electric irons, &c." C. B. Tuppen. November 27th.
29,792. "Means of adjusting coil-holders, &c., for wireless." F. H. Philpott. November 27th.
29,802. "Telephoto objectives." Kapella, Ltd., and H. W. Lee. November 27th.
29,807. "Electro-mechanical apparatus for fire, &c., alarms." J. Trimble. November 27th.
29,808. "Electric protective devices." Schweiz Glühlampenfabrik Akt. Ges. November 27th. (Switzerland, December 26th, 1923.)
29,812. "Wireless receiving apparatus." D. S. B. Shannon. November 27th.
29,813. "Wireless signalling apparatus." D. S. B. Shannon. November 27th.
29,814. "Wireless signalling apparatus." D. S. B. Shannon. November 27th.
29,819. "Attachments for telephone receivers." A. H. Boulton. November 27th.
29,824. "Dynamo-electric magneto lighting apparatus." W. T. Turner. November 27th.
29,828. "Electric adaptors, &c." F. D. Berners and W. Harding. November 27th.
29,833. "Device for use with sparking plugs." R. E. Grant. November 27th.
29,833. "Crystal-holders for wireless systems." G. A. Mitchell. November 27th.
29,865. "Electric indicators." J. R. Quain. November 27th.
29,872. "Electric lighting systems for vehicles." C. A. Vandervell and C. A. Vandervell & Co., Ltd. November 27th.
29,885. "Submarine cables." W. S. Smith. November 27th.
29,887. "Systems of electric ship propulsion." British Thomson-Houston Co., Ltd., and D. E. Jewitt. November 27th.
29,901. "Tuning device for wireless receiving apparatus." F. H. Griffin. November 27th.
29,915. "Electric light fittings." W. McGeoch. November 28th.
29,916. "Electric light fittings." W. McGeoch. November 28th.
29,922. "Inductance coils." F. L. Galley. November 28th.
29,924. "Electric lamps for automobiles, &c." F. J. Miller. November 28th.
29,927. "Battery connections or holders." C. B. Smith. November 28th.
29,929. "Wireless receiving sets, &c." T. Gare. November 28th.
29,931. "Conducting clips, &c., for removable components of electric circuit." R. E. Beswick and P. N. Glendining. November 28th.
29,933. "Inductive coil." R. D. Ball. November 28th.
29,934. "Electric lamp holders." F. Barraclough. November 28th.
29,944. "Filaments for thermionic valves." A. H. S. Colebrooke. November 28th.
29,951. "Alternating-current signalling systems." F. E. Pernot. November 28th.
29,957. "Control of electric motors." English Electric Co., Ltd., and F. Morris. November 28th.
29,960. "Electric condensers, &c." C. G. H. de Laval. November 28th.
29,961. "Electric resistances." R. H. Barbour and J. R. Walton. November 28th.
29,969. "Switching keys for telephone systems." E. R. Garrod, W. E. Goodwin, and Siemens Bros. & Co., Ltd. November 28th.
29,971. "Telemeters." J. J. Bird (R. Bird). November 28th.
29,983. "Choking coils and voltage transformers." E. Pfiffner. November 28th. (Germany, November 28th, 1922.)
29,985. "Authentication of subaqueous sound signals." Atlas-Werke Akt. Ges. November 28th. (Germany, November 28th, 1922.)
29,989. "Oil-insulated transformers, &c." F. Häberle, Sachsenwerk Licht und Kraft Akt. Ges., and W. Sarfert. November 28th.
30,002. "Telephone receivers." R. L. Murray. November 28th.
30,012. "Electric protective devices." Schweiz Glühlampenfabrik Akt. Ges. November 29th. (Switzerland, April 24th.)
30,025. "Dynamo-electric machine." D. Suchostawer. November 29th.
30,032. "Wireless receiving sets." D. K. Gardner and J. Stead. November 29th.
30,044. "Lamps for motor cars, &c." F. Ireland. November 29th.
30,057. "Variable condensers for wireless telephony." W. E. Robinson. November 29th.
30,060. "Head-lights for motor vehicles, &c." J. H. Andrew. November 29th.
30,061. "Telegraphic apparatus." F. G. Creed and Creed & Co., Ltd. November 29th.
30,063. "Apparatus for electrical precipitation of suspended particles from gaseous fluids." Lodge-Cottrell, Ltd. (Metallbank und Metallurgische Ges.) November 29th.
30,072. "Electric wave-receiving systems." Western Electric Co., Ltd. (Western Electric Co. Inc.). November 29th.
30,084. "Electric switchgear." H. Beardall and Metropolitan-Vickers Electrical Co., Ltd. November 29th.
30,085. "Cooling, &c., of dynamo-electric machines." J. A. Kuyser, Metropolitan-Vickers Electrical Co., Ltd., and E. L. N. Towle. November 29th.
30,089. "Telephones, &c." H. J. Round. November 29th.
30,116. "Gasfilled electric glow lamps." Naamloose Vennootschap Philips' Gloeilampenfabrieken. November 29th. (Holland, December 23rd, 1922.)
30,125. "Semi-automatic telephone systems." Automatic Telephone Manufacturing Co., Ltd., and J. E. Ostline. November 29th.
30,127. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. November 29th. (France, January 8th.)
30,132. "Electric discharge devices." British Thomson-Houston Co., Ltd. November 29th. (United States, November 29th, 1922.)
30,141. "Grip terminal for stranded wires." A. Smye. November 30th.
30,142. "Variable electric condenser." M. R. Turner. November 30th.
30,163. "Actuating electric switches for internal-combustion engines." G. Bowman. November 30th.
30,168. "Switch for wireless receiving set." E. Cuddon. November 30th.
30,173. "Wireless receiving apparatus." S. G. Brown. November 30th.
30,175. "Sound-reproducing instruments." R. M. Mackison. November 30th.
30,177. "Foundations for poles supporting overhead lines." Electrical Improvements, Ltd., and W. N. Waggott. November 30th.
30,183. "Acoustic devices." Western Electric Co., Ltd. (Western Electric Co. Inc.). November 30th.
30,187. "Selective and anti-parasitic receiving systems for electro-magnetic waves, &c." Marrec, Ltd., and Y. Marrec. November 30th.
30,195. "Electric oscillation detectors." A. M. H. R. Brown. November 30th.
30,198. "Vehicle head-lamps." Edison Swan Electric Co., Ltd., E. E. Hiatt, and P. J. Sturges. November 30th.
30,207. "Electric condensers." W. H. Wilson. November 30th.
30,209. "Thermionic tubes." F. Trautwein. November 30th. (Germany, December 4th, 1922.)
30,218. "Electron discharge devices." Connecticut Telephone & Electric Co. Inc. November 30th. (United States, December 1st, 1922.)
30,219. "Electrically-heated kettles, &c." Electrical Engineering Small Tool and Gauge Co., E. Tite, H. Tite, J. Tite, and L. H. Tite. November 30th.
30,225. "Automatic, &c., telephone systems." Automatic Telephone Manufacturing Co., Ltd. November 30th.
30,226. "Telegraphic, &c., cables." W. S. Smith. November 30th.
30,227. "Magnetic alloys, and their application in manufacture of telephonic, &c., cables." H. J. Garnett and W. S. Smith. November 30th.
30,238. "Illuminated signs, &c." C. K. Roylance. November 30th.
30,243. "Terminals for electrical apparatus." C. Terry. December 1st.
30,249. "Crystal detectors." J. H. Hewitt, W. J. Hewitt, and Wilkins and Wright, Ltd. December 1st.
30,262. "Trucks, brakes, &c., for electric tramcars, &c." P. Priestly. December 1st.
30,280. "Switches for radio-communication apparatus." H. Baines and J. Burns, Ltd. December 1st.
30,285. "Anodes or cathodes for batteries." A. Ford-Lloyd. December 1st.
30,288. "Regulating devices for dynamo-electric machines." F. L. Hollister. December 1st.
30,295. "Telephones and loud speakers." A. H. Hunt. December 1st.
30,296. "Telephone headbands." A. H. Hunt. December 1st.
30,307. "Electric furnaces." British Thomson-Houston Co., Ltd. December 1st. (United States, December 1st, 1922.)
30,312. "Magneto-electric machines." Magnétos Lucifer Soc. Anon. December 1st. (Switzerland, February 21st.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

1922.

12,970. "Method for the pupinising of high-frequency telephone lines." Felten & Guilleaume Carlswerk Akt. Ges. May 7th, 1921. (179,963.)
13,779. "Trolley-poles of overhead systems of electric traction." H. I. Rogers, and Brecknell, Munro & Rogers, Ltd. May 16th, 1922. (206,879.)
19,434. "Automatic exchange telephone apparatus." A. F. Wood, W. Stott, and Telephone Manufacturing Co., Ltd. July 14th, 1922. (206,890.)
19,676. "Means for starting internal-combustion engines." H. A. Fyrah. July 18th, 1922. (206,893.)
21,601. "Coil-holders for wireless signalling systems." Igranic Electric Co., Ltd., A. H. Curtis, S. R. Wright, and A. H. Mackley. August 8th, 1922. (206,899.)
22,003. "Construction of electric rotary converters." English Electric Co., Ltd., and G. Schroeder. August 12th, 1922. (206,905.)
22,024. "Electric transmission systems." A. M. Taylor. August 14th, 1922. (206,907.)
22,106. "Telephones." N. W. McLachlan. August 14th, 1922. (206,910.)
22,148. "Variable electrical resistances." A. E. Taylor. August 15th, 1922. (206,911.)
22,155. "Receivers as used in line or wireless telephony and the like." M. J. Mason. May 10th, 1923. (206,914.)
22,328. "Electrically-operated driving and reversing mechanism." Vickers, Ltd., Sir J. McKechnie and L. H. Bateman. August 16th, 1923. (206,923.)
22,442. "Automatic or semi-automatic telephone systems." Relay Automatic Telephone Co., Ltd., and B. B. Johnson. August 17th, 1922. (206,930.)
22,876. "Electric switches." A. Green. August 22nd, 1922. (206,944.)
24,839. "Track signals for tramways." J. V. Payne. September 13th, 1922. (206,966.)
25,499. "Telegraph printer." D. Murray. September 21st, 1922. (206,975.)
29,081. "Electrical ship-propulsion systems and control apparatus therefor." L. Miller, J. P. Campbell, and Metropolitan-Vickers Electrical Co., Ltd. October 25th, 1922. (207,005.)
29,130. "Means for transmitting power from an electric motor to the driving shaft of a machine such as a sewing-machine." H. Allbrook and M. Hashfield. October 25th, 1922. (207,006.)
29,574. "Contact rolls for electric welding-apparatus." H. Imrie (F. G. Gale). October 30th, 1922. (207,006.)
29,876. "Electric advertising and announcing apparatus." F. H. W. Cox. November 1st, 1922. (207,016.)
31,483. "Electrically-heated flat-irons and the like." British Thomson-Houston Co., Ltd. (International General Electric Co. Inc.). November 17th, 1922. (207,030.)
34,266. "Electrical switches." F. H. Royce and Rolls-Royce, Ltd. December 15th, 1922. (207,058.)
34,632. "Combined locking apparatus for the distributing switches of electrical installtions for motor-cars." Scintilla. Janury 5th, 1922. (Addition to 182,819.) (191,373.)
34,899. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). December 21st, 1922. (207,060.)
35,496. "Mine signal apparatus." W. B. Dale, R. A. Hopkinson, and J. Hopkinson & Co., Ltd. December 30th, 1922. (207,066.)

1923.

94. "Centrifugally acting mechanisms for operating electric switches or circuit-breakers." British Thomson-Houston Co., Ltd. June 8th, 1922. (198,985.)
1,350. "Ignition distributors." G. H. Taylor. January 15th, 1923. (Addition to 187,120. (207,075.)
2,237. "Automatic train control systems." General Railway Signal Co. (January 26th, 1922. (192,397.)
4,636. "Rotary electric ignition current distributors or commutators for internal-combustion engines and the like." T. D. Taylor. February 17th, 1923. (207,091.)
4,683. "Electrical connectors of the plug-and-socket type." A. N. Penman and D. Smith. February 17th, 1923. (207,092.)
6,124. "Loud-speaking telephones." Ges. für Drahtlose Telegraphie. August 24th, 1922. (202,953.)
14,636. "Alkaline electric batteries." Dr. L. Grafenberg. June 7th, 1922. (199,020.)
27,176. "Head bands or supports for telephone receivers." T. L. Jones. August 16th, 1922. (Divided application on 22,314/23.) (207,130.)

Einstein's Theory.—In a letter to *The Times*, Prof. H. H. Turner states that the third crucial test of the theory enunciated by Prof. Einstein has resulted in the confirmation of the theory. The three tests, suggested by Einstein himself, were: Explanation of the movement of the planet Mercury; the bending of rays of light passing close to the sun; and the change of wave-length of light due to gravitation. The issue in the third case has for a long time been in doubt, but one of the most noted sceptics with regard to this point—Mr. C. E. St. John, of Mount Wilson Observatory—has now announced his acceptance of the predicted result, and his conversion, added to the strong evidence given by Mr. Evershed (late director of the Kodaikanal Observatory in Southern India), appears to Prof. Turner to settle the matter.